GAS

AUGUST 1961

Canada to California

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THE NATION'S NATURAL GAS AUTHORITY

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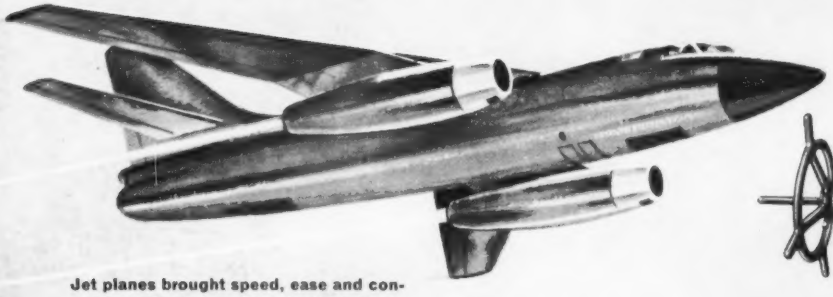

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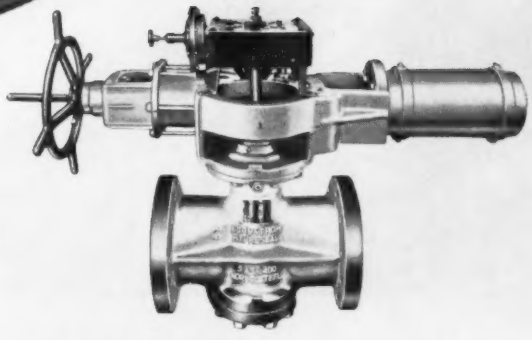

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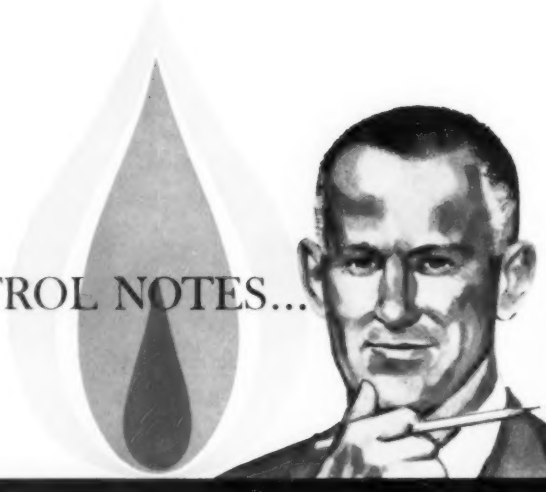

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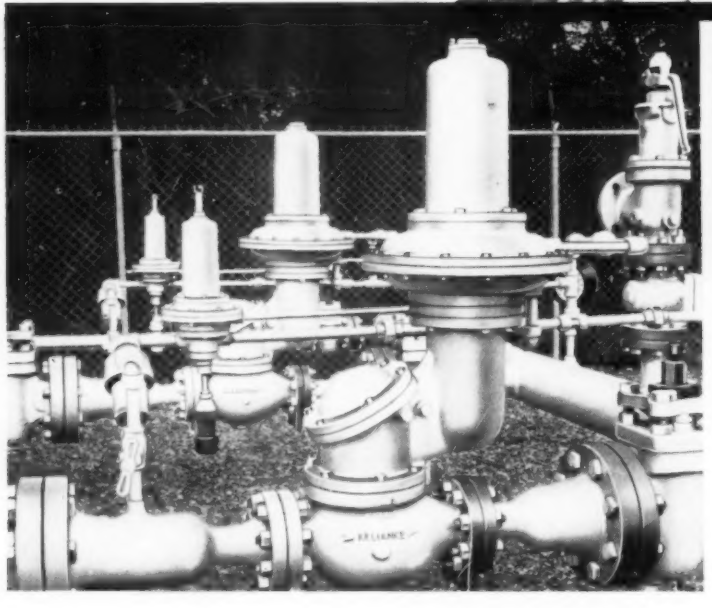

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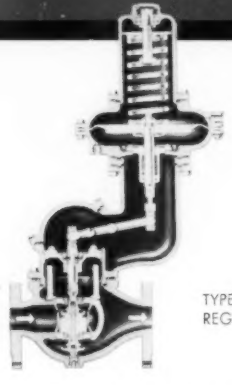

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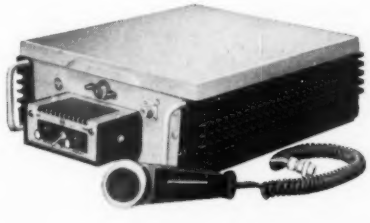

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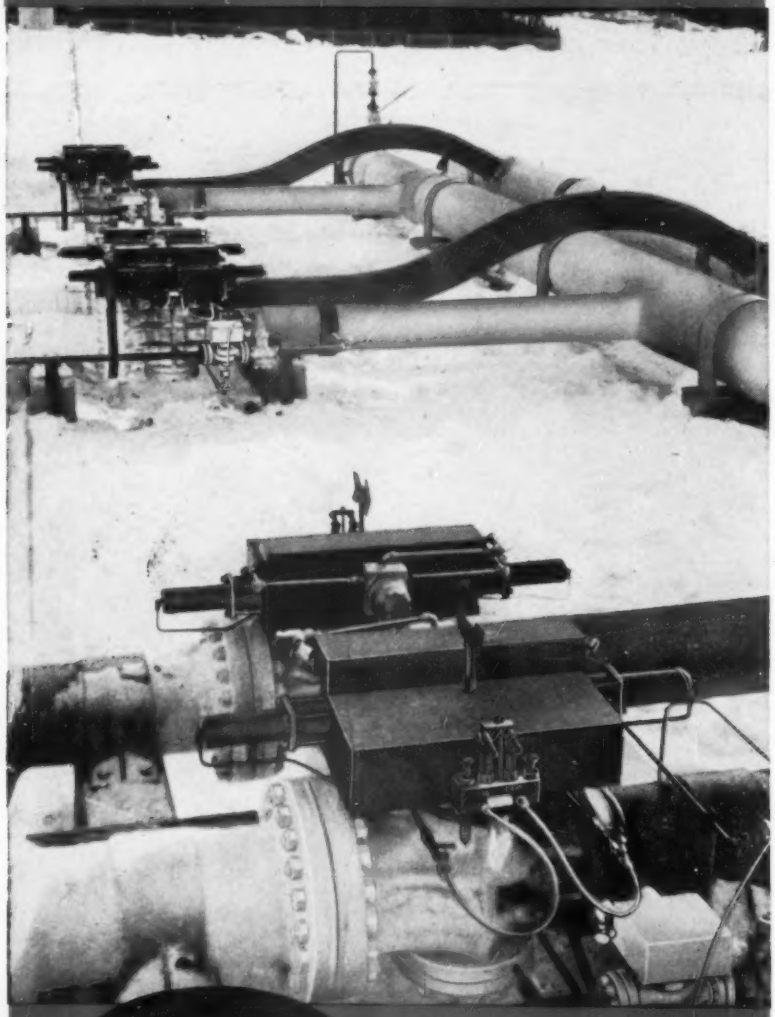

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BPA NBP

CALENDAR

August

17 . . AGA Regional Transmission Roundtable Conference — Cleveland-Pick Carter Hotel, Cleveland, Ohio.

September

7 . . Rocky Mountain Gas Association Annual Banquet—Denver Hilton Hotel, Denver, Colo.

11-13 . . AGA Annual Accident Prevention Conference—Statler Hilton Hotel, Dallas.

14 . . Mid-West-AGA Public Relations Workshop — The Town House, Omaha.

12-14 . . Mid-West Gas Association School and Conference—Ames, Iowa.

13-15 . . Pacific Coast Gas Association Annual Convention—Coronado Hotel, Coronado, Calif.

15-16 . . Maryland-District of Columbia Utilities Association Fall Conference — Cavalier Hotel, Virginia Beach, Va.

18-19 . . Independent Natural Gas Association of America Annual Meeting—Shamrock Hilton Hotel, Houston.

18-22 . . AGA Industrial Gas School — Marriott Motor Hotel, Philadelphia, Pa.

20-22 . . Southeastern Gas Association Annual Meeting—Roanoke, Va.

October

1-4 . . American Gas Association Annual Convention—Dallas

3-4 . . Ninth Annual Gas Measurement Institute (University of Kansas) —National Guard Armory, Liberal, Kans.

12-13 . . California Natural Gasoline Association 36th Annual Fall Meeting — Lafayette Hotel, Long Beach, Calif.

16-20 . . National Safety Council—Chicago, Ill.

18-19 . . Wisconsin Utilities Association Gas & Electric Sales & Operating Convention—Schroeder Hotel, Milwaukee, Wis.

19-20 . . AGA Marketing Research Seminar—Essex Inc, Chicago, Ill.

24-25 . . AGA-NEGA Safety Course — Parker House, Boston.

24-25 . . The Pipeline Institute — Court House, Liberal, Kan.

29-31 . . Independent Petroleum Association of America Annual Meeting —Shamrock Hilton Hotel, Houston, Texas.

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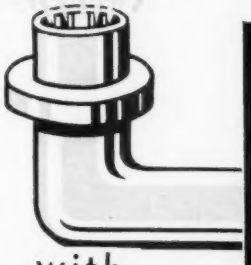
WOMP WOMP WOMP



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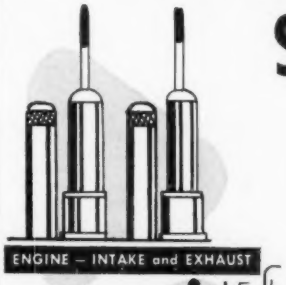

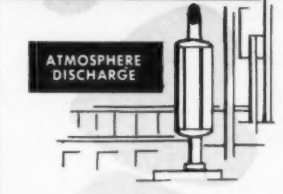

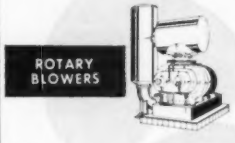

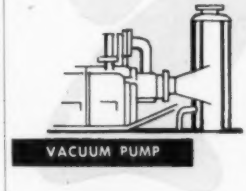

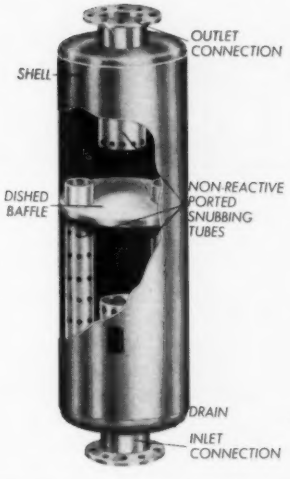

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AUGUST 1961

Thermally Thinking

In which a whale falls in love with a submarine

FINDING it uncommonly hot in Los Angeles as July waned, I went down to the sea. The seagoing was aboard a friend's sailboat. It was a craft with dreadful handling characteristics and of doubtful bottom.

Our little cruise ended rousingly as the aftermath of several masterful maneuvers and some surprising seamanship. Terminal point of our voyage was directly above the vessel's current position—which is right on the Pacific's bottom, some 17 miles nor' nor' west of Santa Catalina island. Otherwise, the sail was relatively uneventful.

We did observe one strange oceanic occurrence. A whale was sighted. Now, there isn't anything exciting about sighting a whale around California. However, this one was surfaced and proceeding through a curious assortment of fluke spanking, ocean-stirring acrobatics, and spectacular spoutings. My friend, who knows absolutely nothing about marine biology, instantly reckoned this whacky cetacean to be engaged in serious courtship.

Devious navigation and confused conning eventually brought us closer to this odd assignation on the plains of Poseidon. We were flabbergasted to note that our whale had directed his amorous attentions to a submarine.

A search of the literature reveals no specific data on incidence of whales falling in love with submarines. And the U. S. Navy will say nothing about the whole affair. My ex-boatowner friend has, however, allowed that at best the whale seemed to be enjoying poor public relations with the Navy.

Later, while drifting quite aimlessly in a dinghy, one had time to reflect on my friend's thought. I saw considerable parallelism with the gas industry's public relations affairs.

While gas-company public relations people raise voluminous paper, verbal and visual rumpuses; it is questionable if they accomplish their objectives. And, like the submarine, in the case of the whale's ambitions; the public, in the case of gas companies' ambitions, offers high resistance for persuasion to an affirmative point of view.

Few people place any value on this nation's having natural gas system and service to most corners of it. Few indicate interest in advantages from this fuel and as served by investor-owned gas companies. Few know that gas prices are regulated by public officials from wellheads to domestic meters.

Several reasons for this have appeared to me. One: Some gas companies' idea of public relation is to keep corporate names, plans and accomplishments, and officials out of public view. For a few, this is the best possible policy. For the majority, it is a costly head-in-the-sand attitude.

Reason two: Some gas company public relations men are unskilled, lacking confidence, unaggressive, lazy, and not dedicated to much of anything except personal empire building.

The third reason—and the most important: public relations people in gas companies are sat upon, trampled, hamstrung, and thoroughly frustrated by management—extending through administrative, technical and operating departments. Too many men "upstairs" imagine themselves more skilled in this complex art than those educated, trained and experienced in public relations. The skilled gas company P/R man is often a mere go-between. He has to get multiple approvals and reconcile too many opinions. His responsibility becomes meaningless. He can't actually practice his trade.

Regardless of what a person thinks about the sport-coat and horn-rim set, public relations is important. If a gas company has any plans for the future, it had better plan to strengthen its public relations department and people, and move them to the forefront.

The gas industry will not realize its predicted growth and progress in the next 50 years unless it is able to project favorable acceptability and social-economic desirability into the public mind. This cannot be gained by giving little more than passing thought to the vital value of public relations in every facet of life in this country.

Weak public relations people, or forceful ones made weak by an umbrella of control applied by those inexpert in the field, will not accomplish much. There are too many skilled public relations efforts in opposition. These are critical roadblocks to gas industry progress.

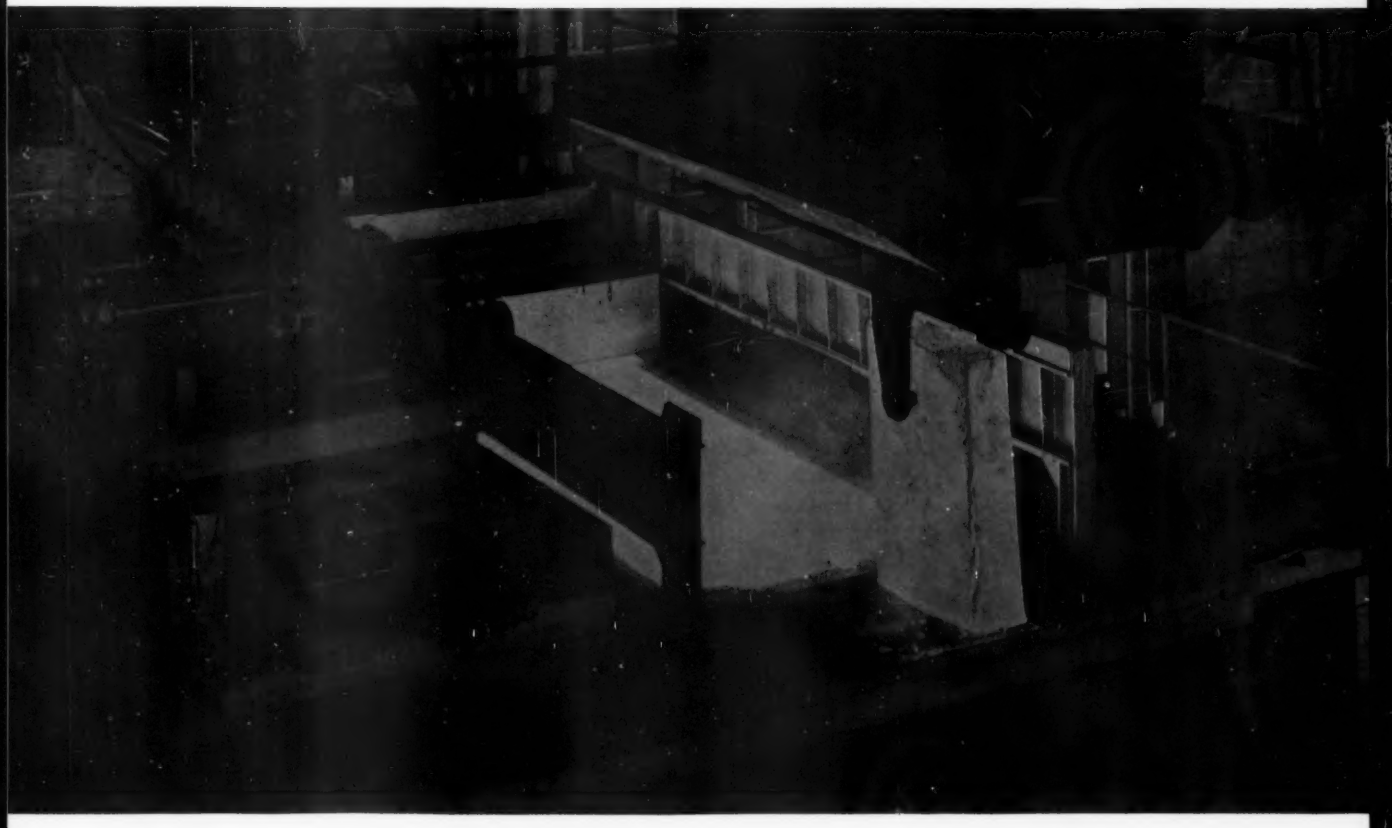
Strong, valid, high-caliber public relations can build shoo-fly roads for the gas industry's passage of many obstacles.

J. Ford Eldan

EDITOR

WE'VE GOT IT MADE... *Almost!*

SEVEN TONS OF ELECTRIC WELD LINE PIPE



Sure, it still looks like cake from the inferno. But into this seven-ton ingot already have gone the most critical ingredients of pipe making . . . those hours in the steelmaking furnace, where quality is born through precise accumulation of raw materials, skillful control and numerous analytical checks. Next come rolling to exact gage, pipe forming, electric welding, hydrostatic testing and end preparation. Then an electric eye to scan the entire surface, to be doubly sure the pipe meets all requirements of customer, API and ASTM. Quality, location and service make Acme-Newport your logical source for 4″ and 6″ sizes, standard or thin wall. Call us!

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	.188″	8.64
	.219″	10.00
	.237″	10.79
6⅝	.156″	10.78
	.188″	12.89
	.219″	14.97
	.250″	17.02
	.280″	18.97

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GAS HIGHLIGHTS

Kennedy-Kuykendall cannonade collapses

On Sept. 1, FPC chairman Kuykendall will vacate that post in favor of Commissioner Joseph C. Swidler. President Kennedy earlier designated Swidler chairman. Best legal advice indicated to Kuykendall that he could continue in the office until his present term expires on June 22, 1962. Quite a tussle had been shaping up over the matter. However, Kuykendall gave in for the good of FPC and to effect a smooth transition. Kuykendall will remain a commissioner; for how long is questionable.

FPC Member's death adds to industry's woes

Death of FPC member Frederick Stueck (July 15, asphyxiated by exhaust fumes piped into his car) means President Kennedy appointees will occupy four of the five commission seats. With three Democrats already nominated (Swidler, Morgan, O'Connor), next appointee must be Republican or independent as law limits party in power to three of the five seats. GAS' Washington Bureau says Stueck's death took everyone by surprise and it's anybody's guess who might be nominated. It's apparent, however, that with four Kennedy men on the commission (Kuykendall is the only Republican), gas industry's problems with the commission will increase.

D. C. Gas Co. to store LPG underground

Washington (DC) Gas Light Co. received green light to construct underground propane-storage cavern. Located in Fairfax County, Va. (just outside of DC), cavern will be mined from rock stratum about 450 ft underground and will hold some 200,000 bbls (8.4 million gals) of liquid propane. Completion expected in Sept., 1962. Fenix & Scisson, Inc., is the contractor.

Those safety meetings must pay off, fellows

Because AGA's latest annual survey—covering 554 companies or 92.7 percent of the gas industry's 211,000 employees—indicates accidents are down 4.1 percent. Gas distributors and pipeliners had only 7.01 disabling injuries per million manhours last year. And, our industry chalked up an improved safety record for 13 consecutive years.

Northern buys Pioneer Gathering

Northern Natural Gas Co., Omaha, has purchased Pioneer Gathering System Inc. Seller is Pioneer Natural Gas Co., Amarillo. Pioneer Gathering purchases, gathers, and delivers natural gas; it also operates 133 miles of gathering system in west Texas. Northern has been a major purchaser. Northern's new subsidiary—Northern Natural Gas Pipeline Co., with W. A. Strauss as president—will operate the new acquisition.

Lease-purchase distribution systems in Arkansas

Arkansas' PSC okayed two applications for cities to build natural gas distribution systems and lease them to utilities under lease-purchase agreements. Residents of the cities approved bond issues to finance the systems. Then, the utilities will operate and buy them under contract. Involved are Arkansas Louisiana Gas Co. and the City of Gillett; Fort Smith Gas Corp. and the City of Waldron—under a joint application; and, Arkansas-Missouri Power Co. and the communities of Marmaduke, Black Oaks, Caraway and Lake City.

FPC gives OK to TET

Texas Eastern Transmission Corp., Shreveport, has FPC authority (temporary) to move ahead with construction and operation of $48+ million in natural gas facilities. Proposed construction—including 293 miles of pipeline, six river crossings, and over 50,000 hp of additional compression—is designed to add about 111 MMcfd to TET's delivery capacity for existing and new customers. However, the temporary does not permit the company to take on any additional sales obligations.

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- Hand operated

T Machine
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- Drills ⅛" through ¾"
- Hand operated

D-4 Machine
- Pressures to 500 p.s.i. at 100°F.
- Drills ¼" through 2⅛"
- Hand operated

DH-2 Machine
- Pressures to 1200 p.s.i. at 100°F.
- Drills ¼" through 2⅛"
- Power or Hand operated

EH-1 Machine
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- Drills ¼" through 1"
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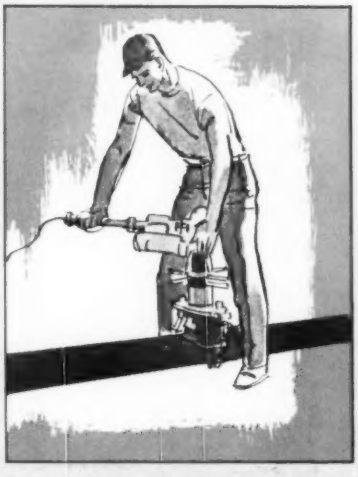

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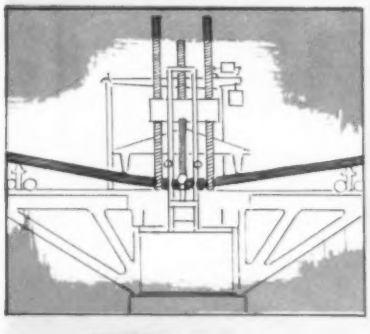

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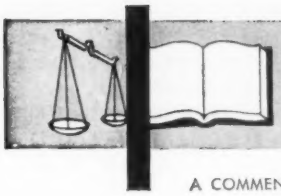

Regulatory and Legislative Trends

A COMMENTARY ON NATIONAL AND STATE DEVELOPMENTS BY AN EXPERT IN UTILITY LAW

Utility rate-making trends

CONTINUED inflation in the cost of labor, materials, and money presents new ratemaking problems to the public utilities commissions. The Maryland commission selected a year-end rate base and return to offset inflation in fixing rates recently for a utility. At the same time, however, it rejected current reproduction cost and trended original cost of utility property as the measure of the present value rate base. Let us review the Maryland Commission's rationale.

• Fair value rate base

The utility asserted the need for a realistic determination of the fair value of its property.

Robert H. Roy, professor of industrial engineering and dean of the school of engineering of Johns Hopkins University, was called as a witness to review the current appraisal rate base produced by other company witnesses.

In Dean Roy's opinion, those studies represent an accurate reflection of the results of inflation upon current values of property.

Dean Roy used the consumer price index, the wholesale price index, the gross private product price deflator, and composite construction costs to demonstrate that price levels have more than doubled in the past 20 years. In other words, the value of the dollar has diminished by more than 50 per cent in that period. He contended that under such circumstances a rigid adherence to an original cost rate base and a constant rate of return produces results to the utility that are tantamount to confiscation of one-half of the value of the property. This situation, he said, does not exist in nonregulated companies that have been able to increase their return on invested dollars during this inflationary period.

The Maryland Commission said that the principal issue involves the determination of the rate base upon which the company is entitled to a reasonable return. The rate base proposed by company, termed a "current appraisal" base, represented the application of a number of different methods of valuation of company's property to produce a result which company contends to be the equivalent of "fair value." These methods of arriving at the "current appraisal" valuation included (a) book cost, (b) independent appraisals, (c) price trend indices, (d) direct pricing, (e) predominant unit costs, and (f) adjustments to book depreciation. The current value of company's property used and useful in its intrastate operation was thus ascertained.

Protestants denied that company's "current appraisal" represented the "fair value" of property for ratemaking purposes and contended that the depreciated original cost of property represented the proper base. The difference between a "current appraisal" rate base and "original cost" rate base was more than $40 million.

The utility contended that due to the impact of inflation the real value of the company's property has eroded to such extent that the use of an "original cost" rate base for ratemaking purposes amounts to confiscation and denies to investors a reasonable return upon their investment. The Maryland Commission did not deny that inflation continues to have its adverse effects upon this and other public service companies. The commission said, "It has been demonstrated before this body upon numerous occasions in recent years that this company's rate of return has suffered some decline. However, upon each occasion that company found its return diminishing below a rate that was reasonable it has applied for and obtained relief."

The Maryland statute requires the allowance of operating expenses, depreciation, taxes and a "reasonable return upon the fair value of the company's property."

The Maryland Commission declared that: "By this statutory requirement we are obliged to determine a rate of return upon a rate base that will produce the number of dollars required by the company to meet its expenses and fixed debt charges, to provide a proper return to its investors in equity, to enable it to acquire new capital at a reasonable cost to assure continued strength and ability to meet the ever-increasing needs of its customers in an expanding economy, and a reasonable amount for retained earnings.

"Just as a governmental body can produce the dollars required to meet its budget by levying a high ad valorem tax on a low assessable base, or a low tax on a high base, so can a regulatory body produce the dollars required by a public service company by allowing a high return on a low rate base or a lesser return on a higher base. In any rate case the rate of return, within prescribed limits, is a judgment figure fixed by the regulatory body after consideration of cost of money, capital requirement, and the other variables in the particular case. This judgment-produced

Continued on next page

rate of return is in itself a variable, changing from year to year as a company's requirements change, and varying from utility to utility depending upon the needs of the individual companies.

"When the regulatory body applies this changing rate of return to a base that is readily measurable and factually determinable, such as an 'original cost' rate base, there is only one judgment figure involved in the body's determination of the case. If, on the other hand, the rate base too becomes variable and changes constantly, as 'current appraisal,' 'reproduction cost,' 'trended cost,' and similar rate bases change with the impact of recessions, business booms, inflation, deflation or other economic trends that elevate or depress current prices and values, then the results of any case depend upon the application of one variable factor upon another. We do not find ratemaking to be an exact science but believe that the fewer the variable factors involved in a rate proceeding the more accurately will the regulatory body be able to forecast the results of its determination and avoid fluctuations in operating income to the public service company and the resultant changes in tariffs its customers must pay."

The Maryland Commission continued, saying: "In our opinion the determination of a rate base arrived at by the use of either 'trended costs' or 'reproduction costs' would, in today's economy, allow the company to reap a return on dollars never invested in plant and would require customers to pay for dollars never spent. In a reverse situation, with prices and costs declining, it could be argued that it would be equally unfair to company to use either of these methods to establish a rate base, the result of which would be to deny the company a return on dollars actually invested in plant."

The Maryland Commission in recent years has given recognition to inflation's adverse effect on businesses subject to regulation. In addition to giving consideration to this fact, in determining the rate of return to be allowed the commission has attempted also to offset the effect of inflation by the use of a year-end rate base rather than an average rate base.

The judgment of the Maryland Commission on rate base came to this reasoning: "Upon consideration of all of the evidence presented in this case we must find that the use of the rate base formerly used by the commission in its determination of rates for this company have produced results that have been fair and adequate in so far as the company and its investors are concerned, and, if the results have been fair and adequate, we assume that the means by which these results were accomplished were proper and reasonable. Having produced these results by the use of an original cost terminal rate base, plus the $3,060,000 increment added in 1951, it is our opinion that such a base represents the 'fair value' of company's property for ratemaking purposes."

L. A. Dixon (left) presents the first "Joe Harper Award" for "meritorious service as chairman of the AGA meter committee" to Robert L. Jones, Michigan Consolidated Gas Co. The plaque will be presented each year by Rockwell to the chairman of the meter committee in honor of Michael J. Harper, late Rockwell vice president.

• Rate of return

The commission placed rate of return in its judgment compartment. Knowing that the growth in demand for service required the utility to spend $40 million annually, the commission recognized its obligation to provide a return sufficient to ensure the attraction of that new capital at reasonable cost.

The cost of equity brought a wide diversity of opinion from the witnesses who testified. The company contended that the overall cost of equity, including a cost of 10 per cent for underpricing and selling costs and at a 75 per cent payout ratio, was 8.9 per cent. People's counsel witness found that cost to be 8 per cent. Another believed 6.79 per cent to be proper.

Just as far apart were their estimates of a proper rate of return, the utility witness advocating 7.25 per cent, public witness 6 per cent to 6.25 per cent, and another expert 5.95 per cent.

The conclusion by the Maryland Commission was: "The wide variations between the opinions of pro-company experts and anti-company experts are not unusual in rate cases before this or any other regulatory body. Such differences are anticipated and appear as a part of well-developed patterns for the presentation of these cases. We may assume that it would be as rare elsewhere as it would be in this state for a commission to accept or adopt either extreme as the views or conclusions of the commission. The divergence of these experts' opinions makes it more incumbent upon the commission to exercise its judgment and more convincing to the commission that a rate of return cannot be determined by fixed formula or inflexible rule. Recent experience indicates it is equally as difficult to anticipate fluctuations in the money market."

A rate of return of 6.3 per cent on the adopted rate base was considered "reasonable and proper" by the commission.

Here is a living utility rate case that shows the trend in ratemaking during inflation.

Whatever combination of rate base and rate of return is used by the regulatory commission, the product in dollars must keep the utility financially strong, or the quality of service will deteriorate. As the United States Supreme Court has asserted—gross revenues should be adequate to cover operating expenses, depreciation, taxes, fixed payments on the debt, preferred stock dividends, and earnings to the common stock equity owners commensurate to those in enterprises having similar risks. ■

62 GROVE G-4 MAINLINE VALVES IN THE ALBERTA-CALIFORNIA LINE

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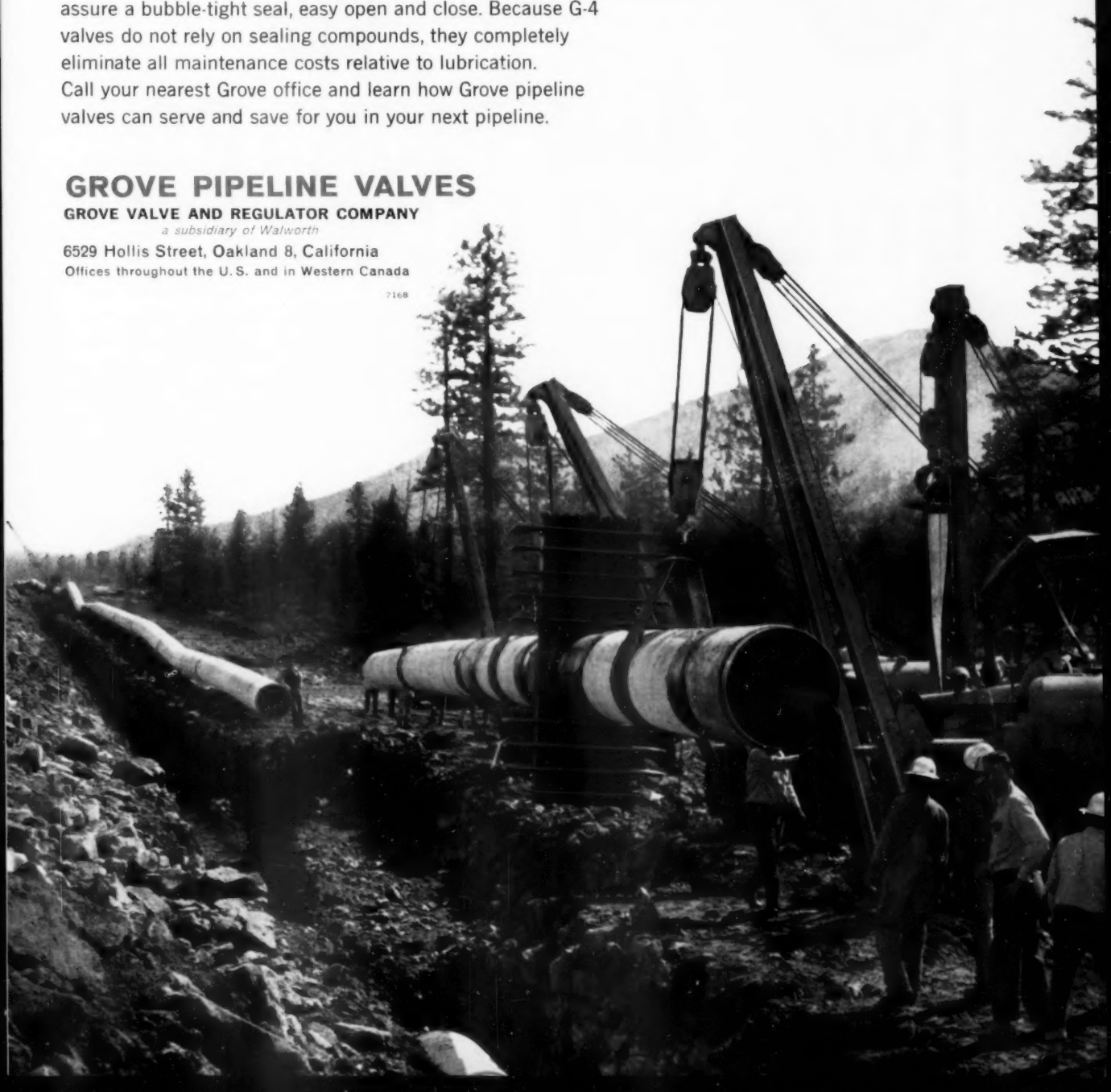

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TECHNICAL TRENDS

By GUY CORFIELD
Professional Engineer,
Los Angeles

Wanted: A synthetic nose

For a great many years researchers have been trying to develop instrumental means for identifying odors and measuring their strength. Such instruments would not only satisfy the ambitions of scientists, but would also be of immense help to industry. Products depending on odor for their value could be closely controlled and rated. Effluents from plants could be evaluated for permissible or objectionable air pollution. All the uncertainties and arguments arising from the vagaries of the human nose could be avoided. The gas industry has been interested in instrumental odor measurement since 1930 when odorization of natural gas became an operating practice.

So far, however, the human nose has remained the deciding factor. Its variation in perception from time to time and from person to person is compensated for as much as possible by obtaining the consensus of a team of "sniffers." Individuals in certain industries—such as perfume—may qualify as experts within their industry. Attempts have been made to develop a numbered set of odorous chemicals and compare the odor to be evaluated with one or a mixture of these chemicals, and then identify the odor by the numbers. This helps to define the nature or type of odor, but not the specific odor or its strength.

In the gas odorization field there are instruments which will quantitatively analyze and record the concentration of certain sulfur components in the gas. Sulfur being the basic constituent of all natural gas odorants, this is of some help. However, it is never certain that the instrument is recording accurately and selectively the type or types of sulfur compounds that are actually responsible for the odor.

There is another means of determining odor which might be described as by inference or analogy. This is typified by a recent gas industry research development. It was desired to find an instrumental method for measuring the odor produced by a domestic gas incinerator, rather than having to depend on the human nose.

The present AGA Approval Requirement for odor emitted by the "smokeless, odorless" incinerator is that it produces no more odor than that given off by the burning of two sheets of crumpled newspaper in an open container as evaluated by three observers. This of course depends on the nasal perception of the observers, and could be argumentative.

An AGA research project was conducted at Battelle Memorial Institute. It was found that the concentration of carbon monoxide in the incinerator flue gases corresponded to and was a reliable measure of the intensity and objectionableness of the odor. With the gas burning only (no charge of refuse) the CO was negligible. As the CO increased in concentration up to 0.65 per cent, the odor could be rated from "slight" to "very strong." Carbon monoxide measurements are, of course, easily made by standard instruments. For anyone interested, the report of this research project, entitled "Development of an Odor-Measurement Technique for Domestic Gas Incinerators," can be obtained from AGA at a cost of $1.

In their continuing study of the human sense of smell, scientists believe that the basic reaction is one of absorption of the odorous gaseous molecules on sensitive surfaces at the rear of the nose or pallet. This causes a change in electric potential at these surfaces or interfaces, which sends an electric impulse to the nervous system and thence to the brain. It would follow that this is a highly selective process so that the different odor molecules produce different electric potentials and therefore different sensations. This is being explored at Armour Research Foundation by applying coatings of various chemicals to gold plates, measuring the contact surface potentials, exposing the surfaces to odorous gases, and again measuring the potentials. Chemicals such as sodium chloride, potassium dichromate, ferric sulfate and boric acid, and gases such as benzene, thiophene, pyridine and acetone, have been used. Significant changes in potential, both positive and negative, have been observed. The report of this work, in the April 3, 1961, issue of *Chemical & Engineering News*, "admits that these are only the first measurements in a vast field of possible systems. But they show that highly specific cases exist and they may speed up the practical use of contact-potential olfactometry."

Cutting or carving stone

A new technique is developing for cutting or carving stone with high temperature torch flame. It has potential use in ornamental stone work, rock quarries, construction projects, and perhaps for drilling in mining operations.

The rapid localized heat of the flame causes the rock to spall or crumble. It is said to work four or five times faster than the conventional chipping methods. It is most effective on the hardest rocks, such as granite. Particularly for production work in yards and quarries, this is a possible new use for natural gas.

Oil-less bearings

Oil-less bearings, which need no lubrication, are coming into a variety of uses all the way from household appliances to aircraft. A type originally developed in Great Britain consists of lead and teflon fluorocarbon powders impregnated into a sintered bronze matrix, with a steel backing to provide strength. They stand up under heavy physical stress, in corrosive and dirty atmospheres, and over a very wide temperature range.

New in principle!

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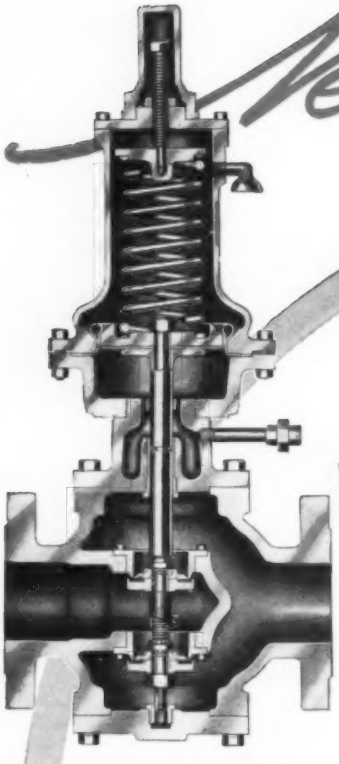

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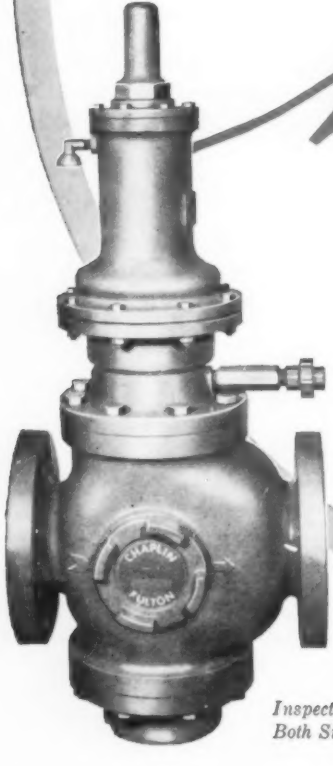

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WASHINGTON

By NEIL REGEIMBAL • GAS Washington Bureau, Washington, D. C.

Harris bill aimed at compromise

THE new Harris gas bill is a skillfully drafted lever, designed to force all factions in the gas regulation fight to wring some sort of compromise out of the battle to solve the problem. But it's a longshot bet, at best.

This is the reaction of many spokesmen on both sides of the main controversy—the gas industry vs. so-called consumer interests.

It has plenty of "kickers" that are crying for amendment to satisfy various factions. At the same time it is designed to force the combatants into admitting that something has to be done and that some provisions are acceptable, one long-time observer notes—a little dryly.

Congressional spokesmen close to Rep. Harris (D., Ark.), the measure's sponsor, say he admits he introduced a "bill to be amended" in order to get action started. The opposing sides of the battle have about five months between congressional adjournment this year and next January to lay their groundwork, make their demands and concessions, and get the measure ready for a serious start.

Even so, it will have trouble breaking through the almost overwhelming series of foreign crises that plague the Kennedy Administration and the preoccupation of the New Frontier with domestic sideshow activities.

Some of the sure-fire amendment areas presumably purposely drafted into the bill include:

* Its failure to give FPC power to regulate direct pipeline sales to industrial consumers. This has been the watchword of the coal interests, demanding control over what they term "dump" sales at off-peak periods. Former President Eisenhower had served notice he wanted such a control in the bill, and it was included in a Harris bill introduced in January. The inclusion in the new measure of a provision giving the FPC the power only to "suspend" sales of gas for resale for industrial use is readymade to be expanded to satisfy the coal industry.

* The provision that the FPC may use costs in arriving at a commodity value of gas is a natural for attack by producers. Rep. Harris has said that consideration of costs as a practical matter can't be entirely eliminated, but there is a chance the provision can be amended to minimize its use by the FPC.

* The inclusion of a prohibition on pipelines from filing one rate increase while another is still pending is another provision ripe for tinkering with, or eliminating altogether. This could go either way, because if the bill's other provisions succeeded in cutting the time lag at the commission, it would not be a problem. Pipelines wouldn't have to wait for the first boost and be forced to add a second.

The bill does include something for everyone. The utility principle of gas regulation would be knocked out in favor of commodity control. Pipelines would get a fair market price for gas they produce. Small producers would be eliminated, as proposed by the White House. And it would give the FPC some administrative changes it has long sought.

The White House, as always, holds the key to the measure. Rep. Harris discussed the general outline with top Administration officials before introducing it, and got some encouragement.

But it will take an outright call for some gas legislation—either as a partial solution to the "mess" at FPC or as a solution to the prospect of future supplies, or both—to get the bill moving with any steam.

This is a real stumbling block. It is unlikely that the textbook-liberal band of White House advisors would issue endorsement of any gas bill which the industry and Rep. Harris could seriously consider.

There is as yet no yardstick for determining how firm President Kennedy would be in using a veto to block a measure which went further than he wanted in a field such as natural gas.

But 1962, when this measure will come to a head, will be a congressional election year, when all congressmen and a third of the members of the Senate are running for their political lives. It is highly probable that the gas bill will become embroiled in some strong political fights, particularly since the Democrats in Congress need domestic issues on which to run.

Reorganization drive delayed

PRESIDENT Kennedy's inclination to gamble on the "calculated risk" of substituting speed for strength has probably delayed for a year or more reorganization of the federal regulatory agencies.

His drive to whip through agency reorganizations, much like the abortive Cuban invasion, was pure

Turn to page 20

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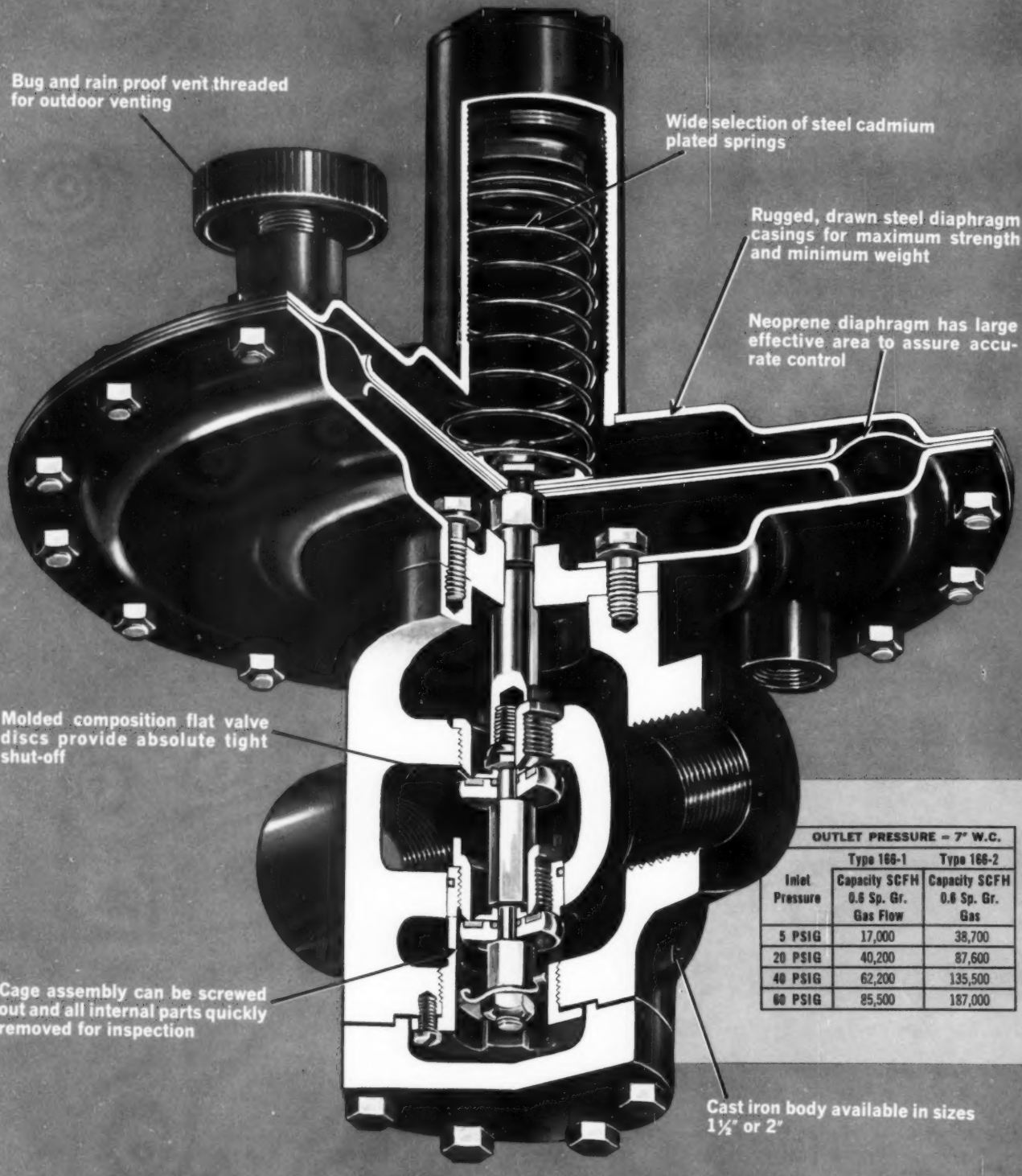
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166-2	2″ Screwed, 2″ 125 lb. ASA Flanged	60 psi	1⅜″	3″ to 5″ w.c. 4″ to 10″ w.c. 8″ to 20″ w.c. 17″ to 28″ w.c. ⅜ psi to 2 psi 2 psi to 5 psi
166-3	1½″ and 2″ Screwed, 2″ 125 lb. ASA Flanged	20 psi	1″	−1″ to +1″ w.c. +1″ to 4″ w.c.

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Continued from page 17

razzle-dazzle, depending for success on catching a stronger team off guard. The Cuban adventure was a fiasco. It's likely now that the agency reorganization drive will be too.

The President successfully won from Congress restoration of power to administratively reorganize these agencies simply by filing his plans with Congress and waiting 60 days for a veto of either House. Theory was that Congress moves slowly, and in the hustle and bustle of the new Administration, it would let them go into effect.

But he pushed too hard. He wanted firm control over the chairmanships of the agencies and "closer liaison" between the White House and the agencies.

The lawmakers balked. Democrats and Republicans alike killed in quick order reorganization plans for two agencies (Federal Communications Commission and Securities and Exchange Commission) with the cry that the White House was trying to "seize control" of these agencies from Congress.

Even Speaker Sam Rayburn, who rarely joins public debate on legislative business, dubbed the moves an attempt by the White House to "amend fundamental law" by administrative action.

While this was only two of possibly six agencies which are expected to be the subject of Presidential reorganization plans, the pattern was pretty clear: Either the President would have to drastically soften his future proposals, or he would have to let Congress slowly arrive at its own reform measures. In the case of the FCC, the House Commerce Committee drafted its own reorganization measure, with some, but not all, of the President's original proposals.

Specific plan for rebuilding the FPC had not been submitted to Congress, probably because of the long delay in Senate confirmation of the two new Kennedy appointees, and the pending fight over who was to be chairman.

But the word around the Capitol was that if the FCC and SEC plans were blocked, President Kennedy's announced intentions for rebuilding the FPC wouldn't stand a chance.

Kennedy wins FPC battle

PRESIDENT Kennedy finally picked up all the chips at the FPC. He won his Democratic majority on the commission and the right to name his own chairman.

Republican Jerome Kuykendall, present commission chairman, agreed to step down on Sept. 1, thus averting a battle and clearing the way for the President to name Joseph C. Swidler, a new Democratic member, to the post.

Kuykendall's decision not to contest his right to keep control of the agency came after Republicans in Congress had carefully prepared a "record" to take the issue to court if the President tried to force the issue. Kuykendall's term ends next June, but he has indicated that he may not keep his post as a member that long.

The Republican said he stepped aside to avoid a fight which might have disrupted the agency's work. Swidler said the President had asked Kuykendall to stay on through the summer to ease the transition from Republican to Democratic control, although Kuykendall and Republican leaders had insisted all along that they did not intend to give up the chairmanship until next year.

No sooner had the Senate approved the nominations of Swidler and Howard V. Morgan to the commission, and the chairmanship issue been settled, than the President prepared to name another Democratic member. This would fill the vacancy created when the term of Republican Commissioner Arthur Kline expired June 22. He was expected to name Democrat Lawrence J. O'Connor, Jr., who was serving as Oil Import Administrator in the Interior Department.

This leaves one Republican on the commission—Kuykendall. But the replacement for recently deceased Frederick Stueck must be either Republican or independent.

The nomination of Morgan to the Commission stirred considerable controversy in Congress. During the heat of the confirmation battle, he was termed a "known perjurer" and "a liar" by Sen. Hugh Scott (R., Pa.), and sharply criticized by others for failing in the past to reveal a police record on federal employment forms.

The police record involved a youthful conviction of assault and battery and a charge, later dropped, of minor theft.

His antagonists insisted that the crimes were not important, but his failure to disclose them was, since this in itself is a crime when federal forms are involved.

Morgan was stoutly defended by his backers. And he was termed a "champion of the (gas) consuming public so badly needed on the FPC." The Senate approved his nomination by a 57 to 27 vote.

Housing program may mean business

GAS industry may get some business out of the latest New Frontier spending program.

Congressional approval of the new $5.6 billion housing program is expected to be the biggest shot in the arm to the home construction industry since FHA was created.

For its biggest push—encouraging creation of new private housing—it depends on ready availability of cash from lenders. Mortgage experts say the program should bring plenty of capital out of hiding.

The new program ups the repayment period from the old 30 years to 35 years, but gives the FHA the power to increase this to 40 years.

For the first time, the FHA can insure mortgages on homes costing up to $11,000 ($15,000 in some high-cost areas) with no down payment for the buyer. Loans for these homes can run 40 years without special FHA authorization.

In another far-reaching provision as far as the gas industry is concerned, Congress raised the limit on home improvement loans insured by FHA to $10,000 from the old $3500, increased repayment time to 10 years from five, and lowered the maximum interest from 9 per cent to 6 per cent.

Under this program, gas distributors have a readymade opportunity to sell new gas kitchen appliances, furnaces and the like. Most of the home improvement loans insured by FHA go for kitchen modernization.

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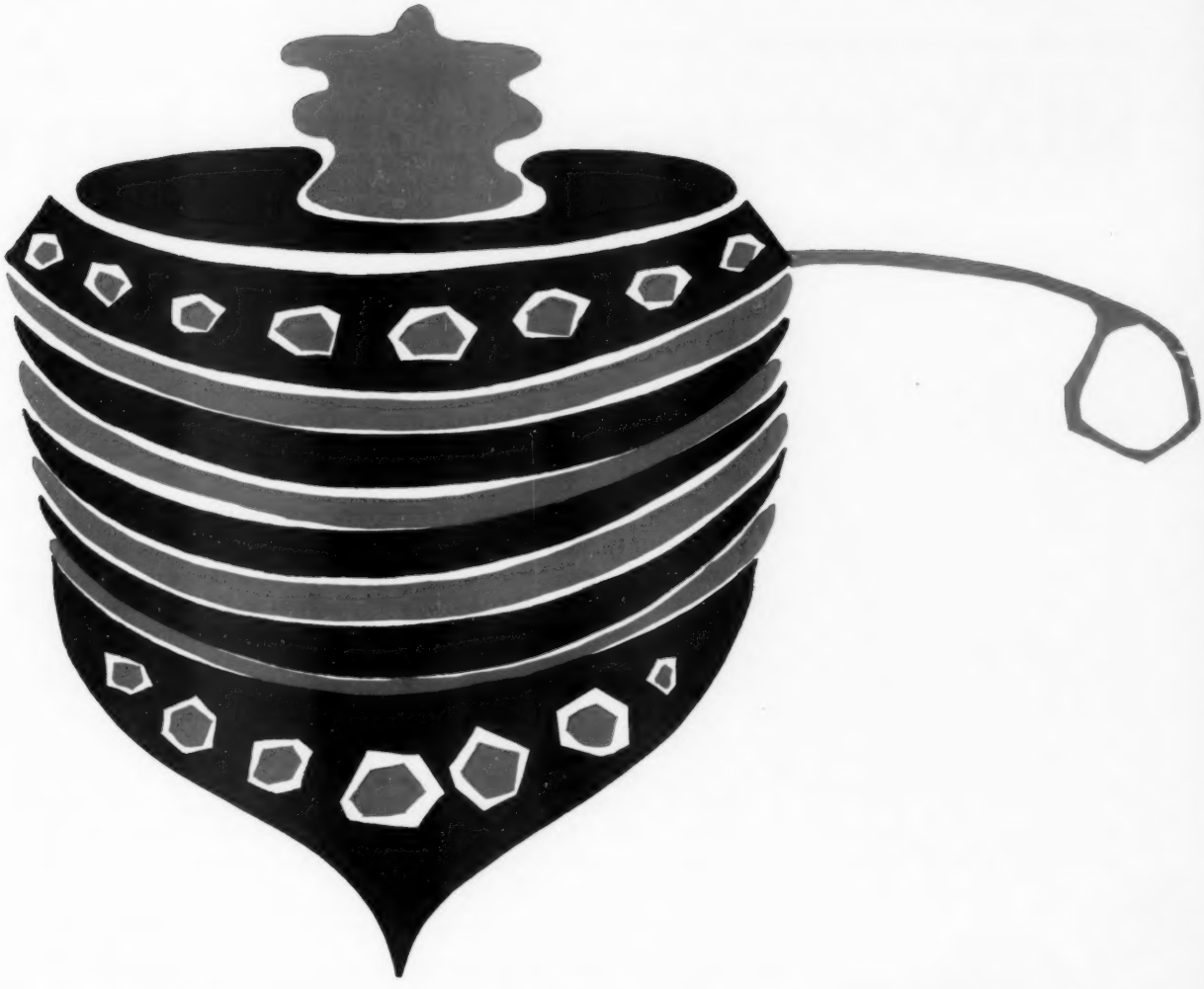

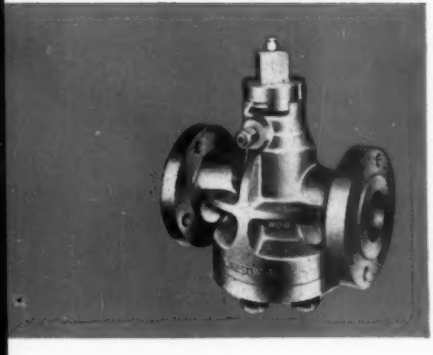

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FOR LONG-LASTING PROTECTION OF SMALL DIAMETER PIPE

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The yellow plastic jacket of Hill Hubbell X-Tru-Coat is one of the most effective corrosion barriers ever developed. It is high-density polyethylene sealed to the pipe by a "live" adhesive for permanent protection against corrosion. It offers maximum resistance to electrical and chemical causes of corrosion. It is unaffected by temperatures from —40° to 175° F. Its flexibility permits severe, short radius bends without damage.

2 HILL HUBBELL SERVICE GIVES YOU MAXIMUM VALUE

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HILL HUBBELL X-TRU-COAT IS NOW AVAILABLE for pipe ranging from ¾" nom. to 4½" O.D. Production facilities are in operation in Youngstown and Lorain, Ohio. The plant in Hammond, Indiana, with transit privileges, will be ready in the near future. For more information and literature, contact your nearest Hill Hubbell representative.

Hill Hubbell X-Tru-Coat is produced under the Dekoron® process (Pat. Nos. 3,447,420 and 3,467,642.)

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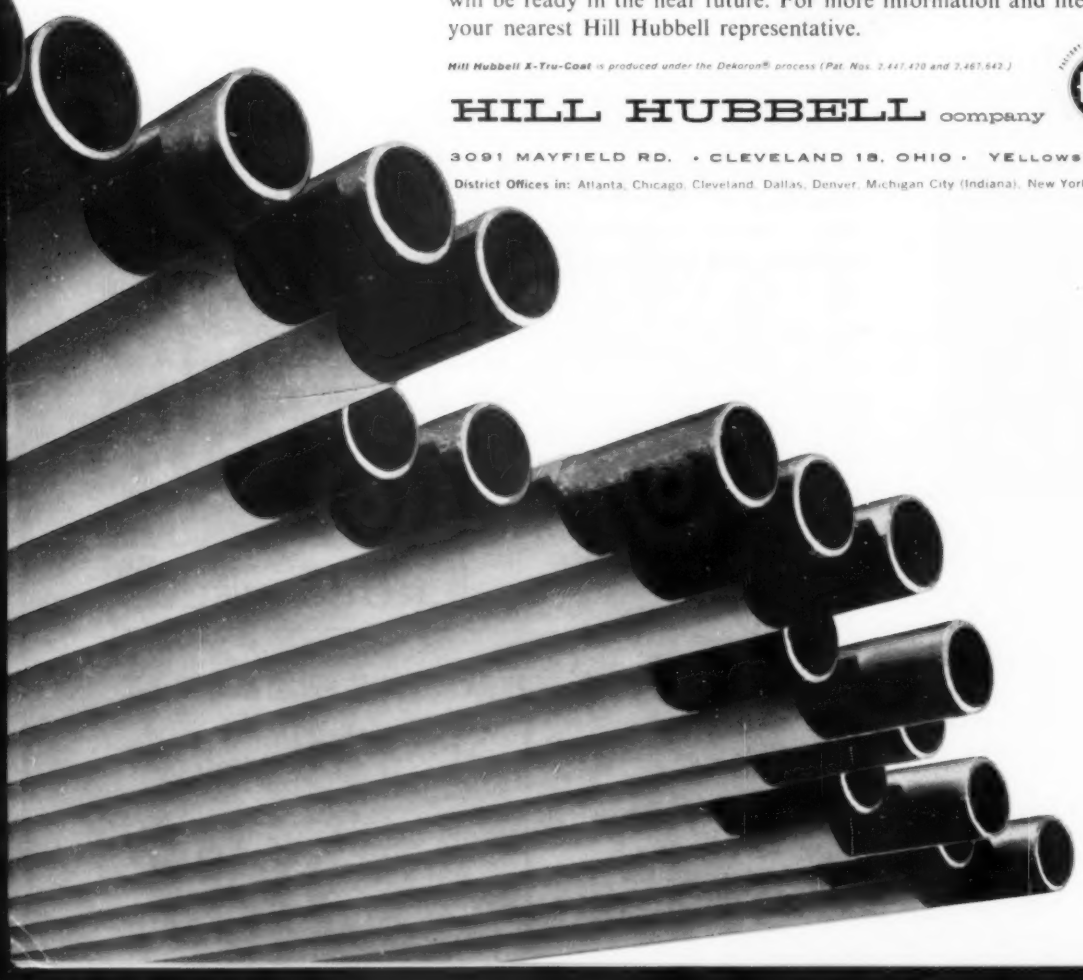
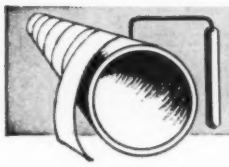




CORROSION PREVENTION

DISTRIBUTION TRANSMISSION

By MARSHALL E. PARKER • Consulting Engineer, Houston

Eyeball engineering

YOU don't use a micrometer to measure a man for a suit. Why? For several reasons; first, it costs too much; secondly, you can't make effective use of the measurements after you get them. The second reason alone is not quite compelling; but with the first, it is convincing. There is certainly no point in paying extra for accuracy that cannot be used.

This is a question which affects every branch of engineering and technology; how much precision is needed, how much is justified, how much can be had. Sometimes we need all we can get, and would like more; sometimes it is very easy to get much more than is needed. Even when it costs nothing extra to get, the temptation to take data with unneeded precision should be resisted, because the preservation, processing, and duplication of the extra information will in itself be expensive.

In the field of corrosion, there are no simple, pat, answers to the question of how much precision is needed, but some guidance can be given. For example, the majority of surveys, either of pipelines or of areas for ground beds, can be done as well by pacing as by taping. Pipe-to-soil profiles, for example, have no need at all of precise location—unless detailed measurements are taken to locate holidays. In this case the actual potential "peak" found can be marked with a stake after it is located. Soil resistivity surveys for the location of hot spots should similarly be paced, with every identifiable landmark tied in. Then when the anode design has been made, and installation is under way, repeat resistivity measurements should be taken to ensure that the anodes are installed in the right soil.

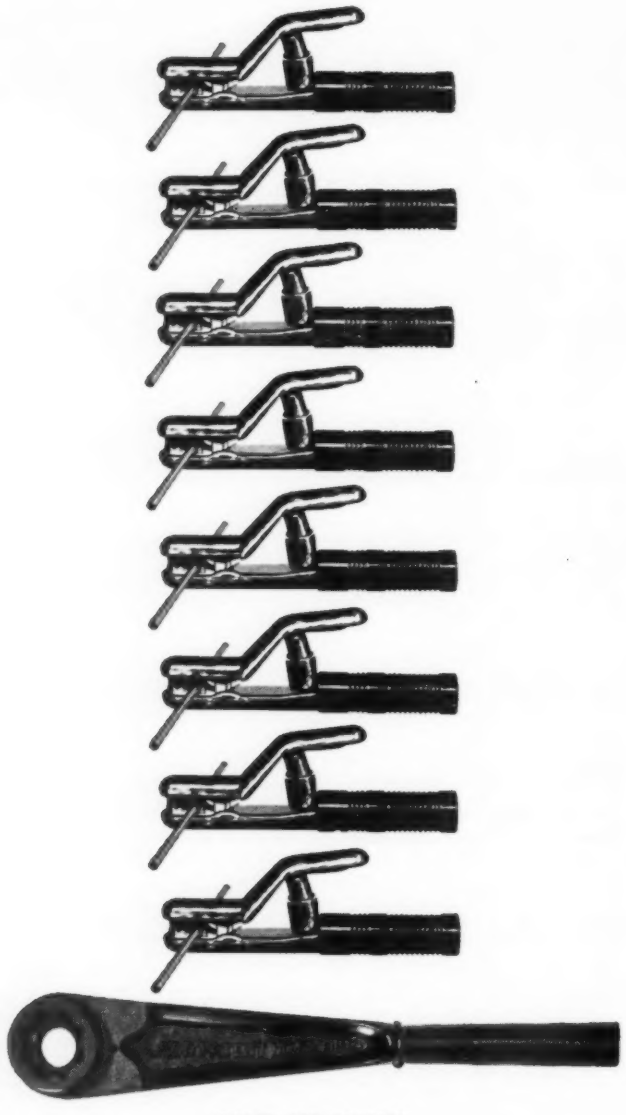
The various readings taken in surveying a ground bed site can similarly be located with adequate accuracy by pacing. However, when the installation is made, the actual location of all the components — anodes, cables, etc. — should be determined by careful taping, and referred to readily identifiable permanent landmarks to the nearest foot. This is necessary both for the land department's records and to permit the re-location of anodes in case of trouble subsequent to installation.

To how many places should pipe-to-soil potentials be taken? Readily available instrumentation makes readings to the nearest millivolt quite simple and rapid. Some time can be saved by using other instrumentation which will read only to the nearest tenth of a volt. When the sole purpose is to determine whether or not the particular line is protected, then there seems little point in recording millivolts; there is even some temptation to record only "yes" or "no" to the question as to whether the measured potential is as great as 0.85 volt or not. But some consideration should be given to the fact that readings are not actually taken at *all* points on the line in question; they are taken at a finite set of points, and from this limited set of readings, the engineer must decide whether or not the entire line is protected. This requires extrapolation; and it seems that readings to the nearest hundredth of a volt are those of optimum accuracy. There are two considerations which rule out the reading to millivolts; the temperature coefficient of the usual copper/copper sulfate electrode, and the fluctuations to be expected if the electrode is moved a few inches. Either of these can produce changes of several millivolts, but will be little felt in the hundredth's place; and the extrapolation mentioned above leads us to desire all the precision which is *easily* and *cheaply* obtainable.

On the other hand, when current requirement surveys are being run, or coating conductance measurements made, there is every justification for taking readings to the nearest millivolt. Neither of the objections cited above is in operation; the two readings involved in determining a value of $\triangle E$ are taken in rapid succession, so there is no appreciable temperature change in the electrode; and they are taken without moving the electrode, so there can be no change in position. There is a very real and significant difference between a $\triangle E$ or 2 millivolts and one of 4 millivolts; but this cannot be determined if readings of potential are taken only to the nearest 10 millivolts. There have even been cases where $\triangle E$'s of less than 1 millivolt have been recorded and used with apparent success and consistency.

The potential difference between two nearby (100 ft to perhaps 400 ft) points on a pipeline, which constitutes the IR drop in the line due to a current flow, and which is measured in order to determine that current, must be measured with an accuracy of 0.01 millivolt; this is of two orders of precision higher than the potentials we have been discussing. This position is justified, not only by the existence of instrumentation with which measurements of the desired precision can be made, but also by the consistency and reproducibility of many hundreds of such

Continued on page 52



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THE GASSING GAME

By **JIM CLARK** • Gas & Oil Consultant, Houston

DEAN James M. Landis disappointed about 1000 members of the American Association of Petroleum Landmen last month when he failed to show up as the featured speaker for their national convention in Houston.

This was a mistake on the part of the "overseer" of federal regulatory agencies. He would have had a warm, friendly welcome and a respectable and attentive audience. In the progress of his talk he might have conveyed some of the government's side of the regulatory problem to the landmen and, especially, the news media of the Southwest. On the other hand, the Dean might have learned a few things himself.

His abrupt cancellation of the speaking engagement won him no friends. No one present really believed that there was anything so urgent going on at the White House, so far as the Dean was concerned, to necessitate such rude action.

Most of the petroleum press corps was not too surprised at Landis' cancellation. While they didn't actually believe that he would run out, they were surprised at his acceptance of the invitation in the first place. They were especially surprised when it was said that the "overseer" would submit to questions from the convention floor after his address.

Many who are familiar with the Landis arguments, particularly regarding the Federal Power Commission, believe he stands on ground that is soft as quicksand in spots.

But it wasn't that fact that caused the boos and jeers when his telegram of cancellation was read to the membership. It was the sheer disappointment in the man. He had gained some stature in accepting. He lost it all among the landmen and the members of the press when he cancelled.

Landis sent a message. The convention chairman was not going to even read it until Eliot Janeway, the economist and another guest speaker, suggested that part of his own time be taken for the Landis message.

Much of what Landis said in his message was worthy of consideration, but it drew no applause. The message also posed several questions to which the landmen would have been happy to have heard some answers. For instance, he said the laws of supply and demand are not enough to solve the industry's problems. Most men who live in a free competitive society believe that the laws of supply and demand should go a long way.

In his message the Dean of Regulation said the failure to solve the gas regulatory problem had "aroused the indignation of the large consuming population in the North." He might have been informed, had he gone to Houston, that it had also aroused the indignation of the large producing and tax-paying population in the Southwest. Maybe some aspects of the problem have also aroused consuming populations in the South, the West, and the East, if not, indeed the good old Midwest. But Landis seemed more worried about the northern consumers than anyone else.

Landis telegraphed his audience also that failure to solve the regulatory problems in natural gas "threatens further expansion of production and transmission facilities, and may dull the incentives to explore and develop further reserves of natural gas."

It was in this part of his message that the Dean would have received one of those standing ovations the appreciative and enthusiastic landmen gave Janeway and L. F. McCollum and other speakers on the program.

The Dean might have been asked exactly what he meant by these words since they just don't sound like him. They sound like something that might have been taken out of an API or IPAA press release. Those lines could be something tricky, like his recommendation to relieve small producers from regulations while keeping big producers under utility-type controls. Even the Dean has admitted that this merely serves the purpose of speeding up the docket and holds no benefit whatsoever for the little producer. The big producer will still set the price pace under federal regulations.

If I had been able to ask the Dean a question, I believe it would have been why he didn't recommend that the letter and spirit and intent of the Natural Gas Act of 1938 be carried out. It was flatly stated in the body of the Act that its provisions did not apply to producers. Then it was repeated. But it was on this very act that the Supreme Court, in one of its wildest moments of total disregard for congressional intent, handed down the iniquitous and unconstitutional decision in the Phillips case.

Landis might argue with that description of the court's decision. But he didn't give anyone a chance to learn whether or not he would. ■

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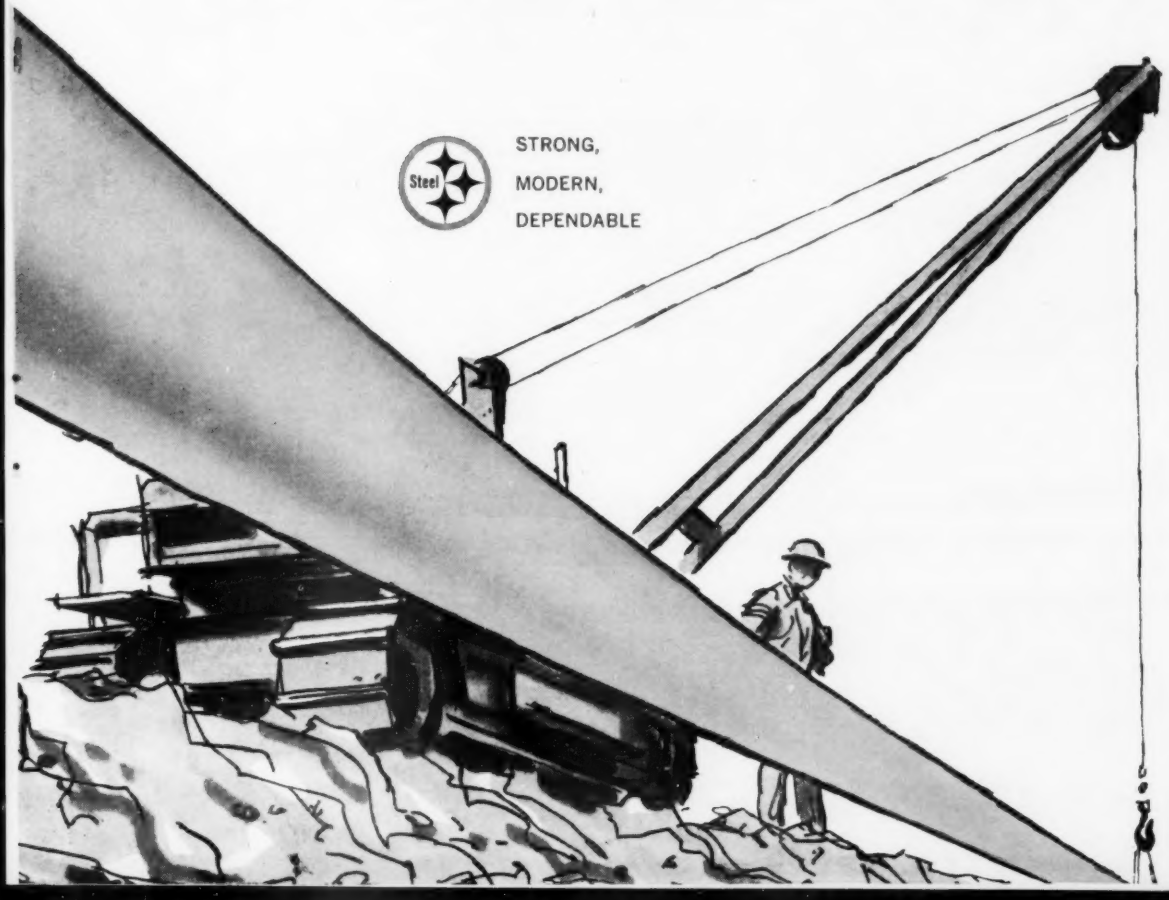


DELCO
CHEVROLET

OLD PRO

That truck engine on the opposite page is one of Chevrolet's famous Thriftmaster 6's—and if it looks a bit battle-scarred, there's a good reason! This one has just turned 230,000 miles, working for Earl McDaniel of Dallas Texas, on a hustling round-the-clock air mail delivery job. *And here's the stopper: this engine has never been overhauled. It has required only routine maintenance over all those miles.* That, you'll agree, is professional *truck* power at its dollar-saving best. That's the way it is with the most widely used engine in the business—Chevy's Thriftmaster 6!

Rarely does any truck engine—even a Chevy Thriftmaster 6—run up a performance record like this one. We point it out here merely as proof that the Thriftmaster 6 brings *staying power to spare* to any job it tackles. It's evidence that Chevrolet puts real *truck* "horses" under the hood—in a light-duty power plant that's built to outlast and outsave any other you can name.

Hustling air mail from airports to town on a stop-watch schedule is a 24 hours a day, 7 days a week responsibility Earl McDaniel, U.S. Mail Contractor, shares with his '59 Chevy ½-ton panel. And, according to Mr. McDaniel, after 230,000 miles, the truck "still purrs like a kitten . . . hasn't had or needed an engine overhaul. The pan has never been off, the valves have never needed grinding."

The Thriftmaster 6 provides the basic power for Chevy's conventional light-duty truck line. *Standard* in pickups, panels, light-duty stakes, delivery vans and the Suburban Carryall, it's the end product of many years of engineering refinement.

It provides economy-contoured camshaft and improved carburetion to give you extra power, extra miles from every gallon of gas. Also, there's a forged steel crankshaft, high quality steel and steel alloy valves, durable precision bearings, full pressure lubrication system, oil-bath air cleaner—all contributing to longer engine life and greater overall economy. This is the most experienced truck engine in the business, and it's ready to wade into your roughest work and keep you way ahead on fuel and maintenance expense. It'll pay you to check into it at your Chevrolet dealer's! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

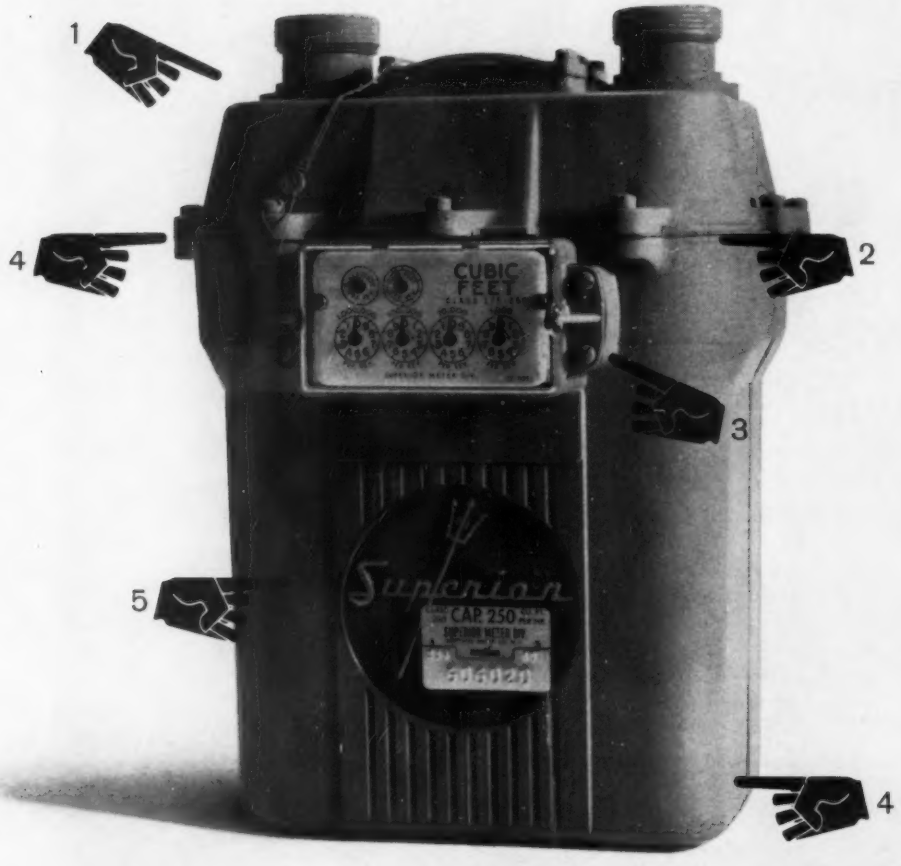
THRIFTMASTER 6 PERFORMANCE DATA

Gross Horsepower	135 @ 4000 rpm
Net Horsepower	115 @ 3600 rpm
Gross Torque, lb-ft	217 @ 2000 rpm
Net Torque, lb-ft	195 @ 2000 rpm
Piston Displacement	235.5 cubic inches
Bore and Stroke	3 9/16" x 3 15/16"
Compression Ratio	8.25 to 1

1961 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET

HOW TO RECOGNIZE A **MODERN** GAS METER



Modern gas meters are superior...

because of improved design and construction. Superior gas meters are modern for exactly the same reasons. The Superior AL250 is a perfect example of a modern gas meter. A few of the reasons:

(1) APPEARANCE: Trim and colorful. (2) HORIZONTAL SEAM: Simple, horizontal seam eliminates leakage, makes maintenance faster and easier. (3) INDEX: Can be removed independently without disturbing cover. (4) HANDLING: Broad base for conveyorized handling; cupped side flanges for easy, safe carrying. (5) SUPERIOR: The name is your guarantee of advanced design (inside and outside), accuracy, and long-term dependability.

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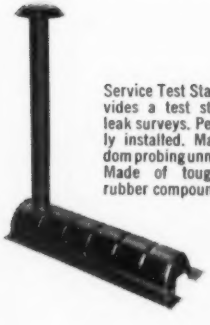
Check the cost saving . . . time saving features of Handley Industries line of gas service equipment.

End call backs with attractive Handley outside meter boxes. Made of tough, resin-rubber compound*. Single meter cover shown. Models also available for double meter installation.

Roadway Valve Box. Designed to reduce the danger of vehicles damaging valves and gas mains. Constructed of tough resin-rubber compound, they telescope freely. Never rust. Never rot. Weight, only 9 lbs. each.



Service Test Station. Provides a test station for leak surveys. Permanently installed. Makes random probing unnecessary. Made of tough resin-rubber compound*.

Handley Cathodic Terminal Box. Landscape engineered and non-corroding*. Leads are attached to the terminal block in the cap for easy testing. Magnetic top for easy locating.

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Leading utilities the country over are standardizing on Handley lifetime curb boxes for sound business reasons. Here are just a few . . .

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- Handley telescope design prevents damage to both piping and service stops.
- 7 times lighter than cast iron, they're easier to handle . . . easier to store . . . and easier to install.
- Constructed of a resin-rubber compound* they won't rust, or corrode, *and are free from electrolytic action*, and are built to last a lifetime.

Fully assembled, light-weight Handley curb boxes are easier, faster, and safer to install. Cut installation costs.

PROVE TO YOURSELF THAT HANDLEY CURB BOXES CAN PAY OFF IN GREATER EFFICIENCY AND ECONOMY FOR YOU. WRITE FOR THE FACTS TODAY.

* A. B. S. Polymer

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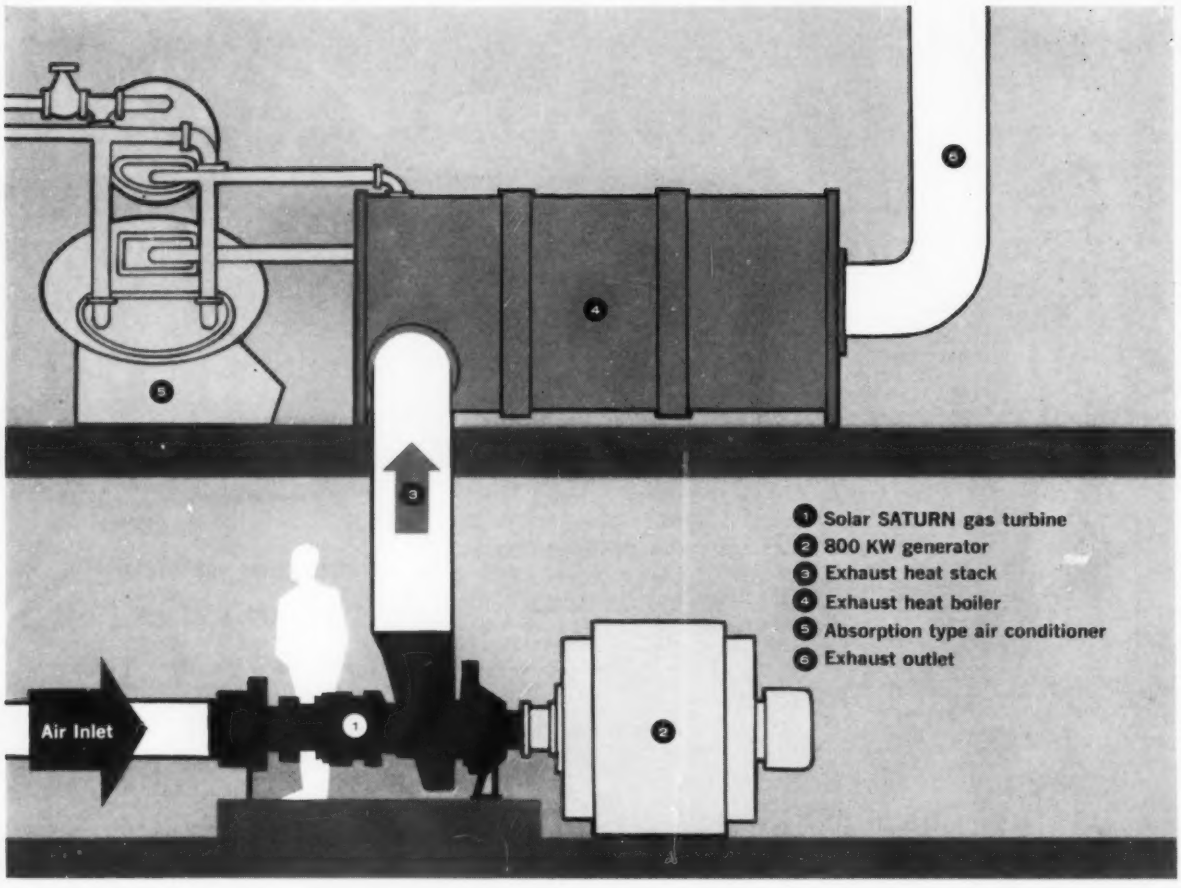
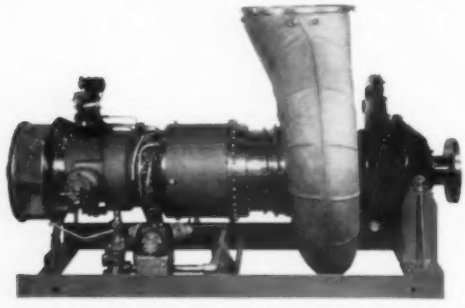


Solar gas turbine exhaust heat multiplies thermal efficiency

This unique system of efficient exhaust energy utilization illustrates one of the many advantages of Solar gas turbines. In addition to the turbine's main shaft power, exhaust gases can be put to work to multiply the thermal efficiency of the installation up to three times that of the prime mover alone.

In the typical system illustrated above, Solar *Saturn* gas turbines turn 800 kw generators, providing electricity for lighting and machinery. Turbine exhaust heat is passed through a boiler to provide steam for process or building heat and absorption air conditioning.

This installation with three *Saturn* engines produces 2400 kw of electrical energy and 16,150 lbs of steam per hour. The complete package fits in a 60 ft by 40 ft space. The turbines will run on gasoline, kerosene, diesel fuel and natural or manufactured gas.



Exhaust heat utilization systems are easily adaptable to any job where electric power generation is needed, such as manufacturing and processing plants.

Solar gas turbines with their light weight, compactness, lack of vibration, long life and instant start capabilities are ideally suited for such jobs as electrical power generation, pumping, field and pipeline compression, oil well servicing, vehicle or marine propulsion.

Solar's family of gas turbines, from 50 to 1100 hp, are designed specifically for industrial use. Their design and manufacture are the result of over 15 years of experience. For further information, write to Dept. J-126, Solar Aircraft Company, San Diego 12, California.

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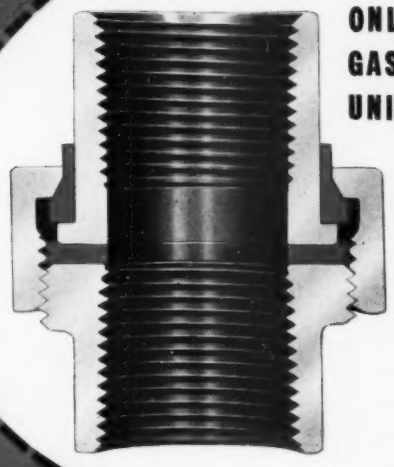

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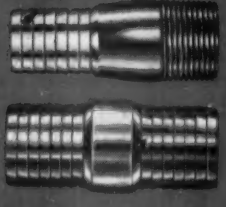

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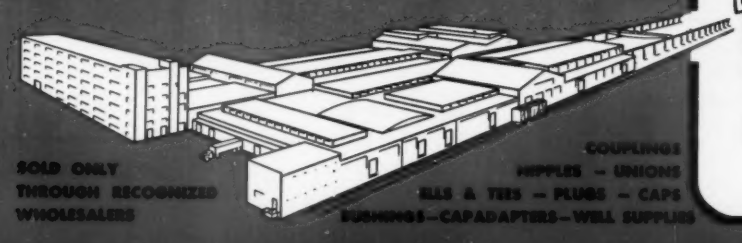

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**Based on a comparison of latest available manufacturers' suggested retail prices*

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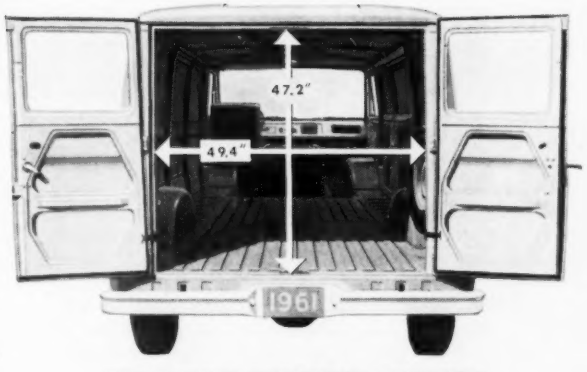
TOTAL FIRST YEAR SAVINGS... $414

and you keep saving

$102 EVERY YEAR!



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SEMI-RIGID PIPE *made of* ABS *Plastic*

NON-CORRODING ABS PIPE SYSTEM OFFERS NEW PROOF OF INSTALLATION, MAINTENANCE ECONOMIES

Light-weight ABS pipe is helping Arizona Public Service Company keep pace with the expanding demand for natural gas service in new suburban areas, such as Fairway Estates in Phoenix. For dependable, long service life and safety, this major utility specified ABS pipe in distribution mains and house service lines; now installs up to 35 house services per day with a six-man crew. Ease of handling, ease of joining through solvent welding, and lower maintenance costs are advantages inherent in ABS pipe extruded of CYCOLAC brand polymers by Arizona Plastic Extrusion and Southwestern Plastic Pipe Company of Arizona.

The full story of the unique properties of ABS pipe is told in a remarkable twenty minute motion picture film. For a free private showing, write to Dept. F-8.

BE *ABSolutely* SURE . . .
INSIST ON RIGID ABS PIPE
made of
CYCOLAC®
BRAND POLYMERS
THE BORG-WARNER PLASTIC THAT IS TOUGH, HARD AND CORROSION-RESISTANT

MARBON CHEMICAL WASHINGTON — MARBON B-W CHEMICAL — DIVISION **BORG-WARNER** WEST VIRGINIA

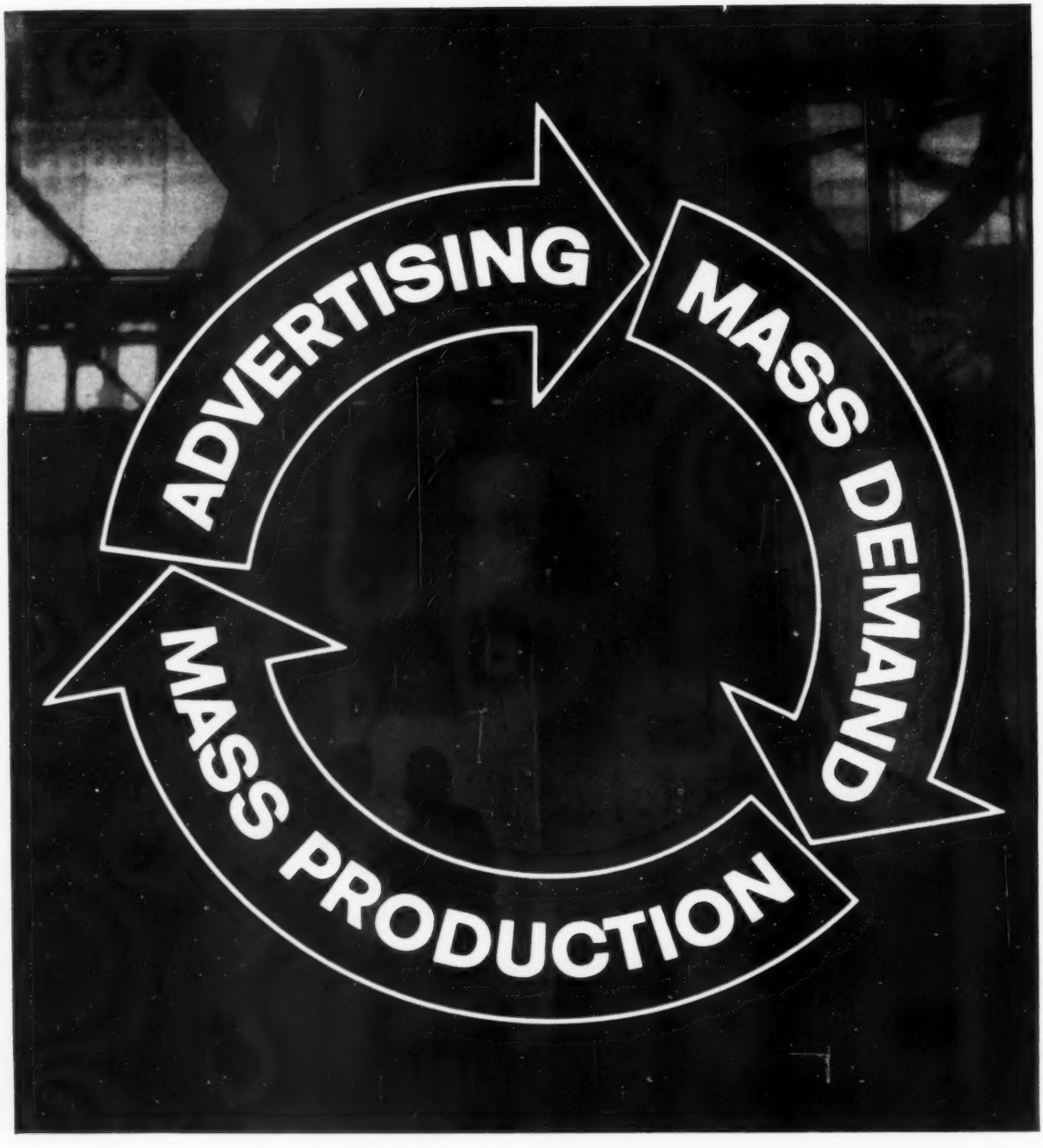
CYCOLAC is the registered trademark of Borg-Warner

Join the companies that help keep the GAS INDUSTRY on the move

These seventeen market-wise companies are on the move, actively supporting the nationwide GEM campaign to promote the greater use of Gas for major household appliances. Their aim: greater growth and prosperity for the *entire* Gas Industry.

All suppliers to the Gas Industry are cordially invited to join this worth-while activity. Write to the Gas Equipment Manufacturers Committee, Room 2925, 60 East 42nd St., New York 17, N. Y.

NOTE TO UTILITIES: FREE mats and reprints of GEM advertising are available for your use in local ad campaigns, over your name. Write to GEM today.



Let's Keep Rolling Ahead

We Americans invented mass production, then we *had* to build mass demand to keep the wheels turning. For this purpose we called upon advertising – the most effective and economical means of creating mass demand. Soon we had more jobs, higher incomes, and better living conditions. And there isn't any limit to how much farther we can go, if we just keep it rolling!

New Peerless Gas Cleaner development provides cleaner gas at less cost

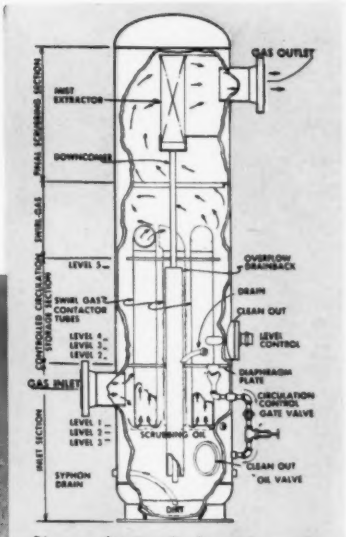
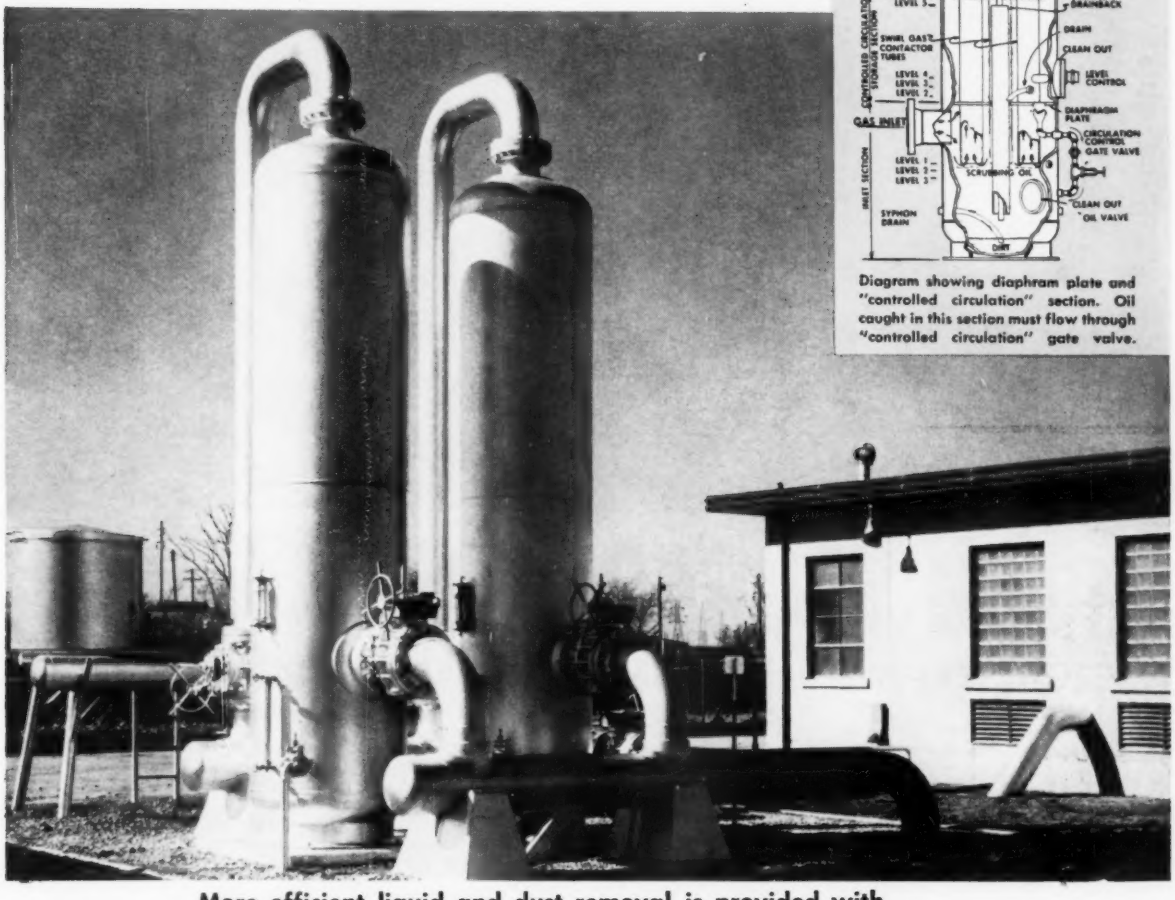


Diagram showing diaphram plate and "controlled circulation" section. Oil caught in this section must flow through "controlled circulation" gate valve.



More efficient liquid and dust removal is provided with Peerless "Controlled Circulation" Vertical Swirl-Gas Cleaner

With given gate valve setting, circulation of scrubbing liquid varies within narrow range even with widely varying gas flows . . . thus greatly reducing scrubbing oil loss. Scrubber will remove small quantities of dry solids or separate large quantities of liquid equally well with no adjustments required. In addition there are higher gas capacities because of limited mist extractor loading, less entrainment at gas exit end of contractor tubes, and use of larger mist extractor.

For details, Write for Peerless Bulletin 6-193.

Write today for information on the new color film, "Engineering Makes the Difference", showing various applications of Peerless separators, engineering, testing, and manufacturing facilities.

SEPARATORS:
- Liquid Vapor

DUST SCRUBBERS:
- Wet and Dry Types

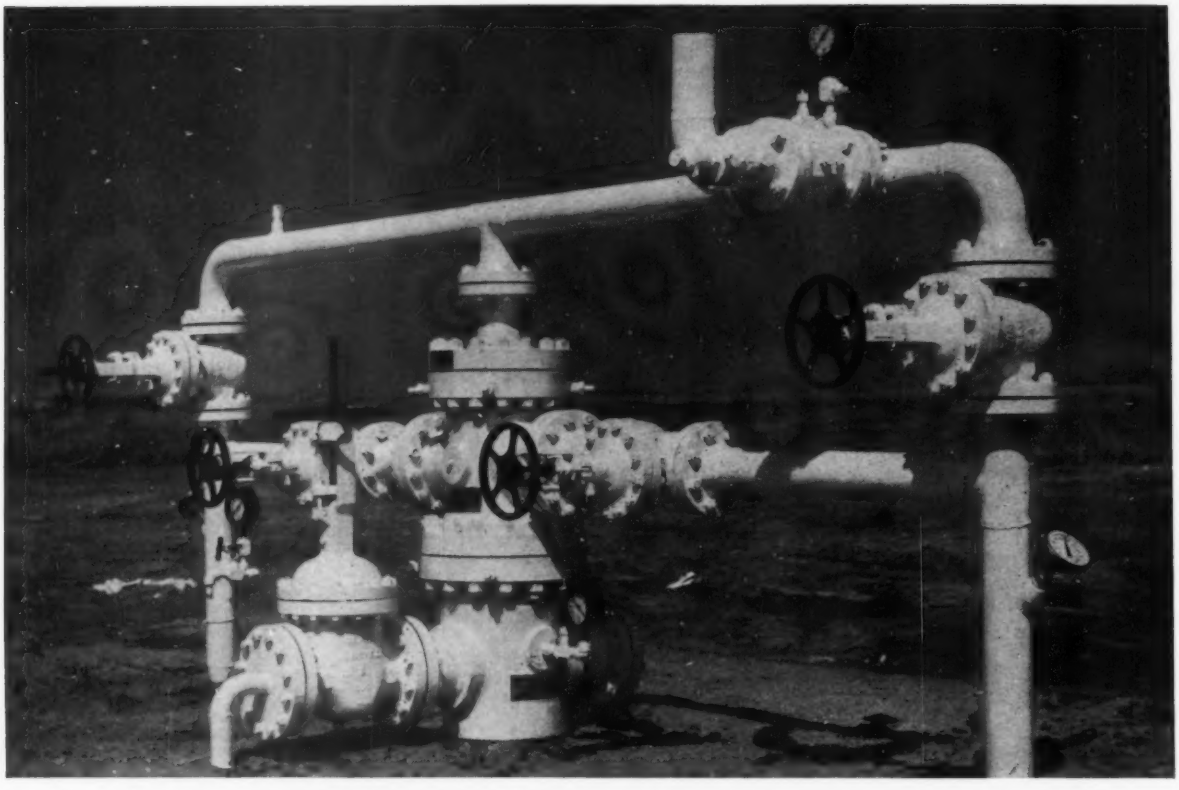
GAS FILTERS
GAS ODORIZERS
SILLERS CLOSURES
OTHER PRODUCTS:
- Engine Timers, Scraper Traps, Manways

PEERLESS MFG. CO. TULSA, TEXAS

PEERLESS MFG. CO.

Representatives in All Principal Cities

P. O. Box 13165 • Dallas 20, Texas



FOR STORAGE WELLS TOO!

RECTOR SEAL-WITH-STEEL INSURES SAFETY—PREVENTS LOSS

The underground storage of liquefied petroleum gases is becoming increasingly important in solving the problems of seasonal storage of butane and propane gases.

Of vital importance to underground storage is the surface equipment necessary to insure safety of operation, and to prevent loss through leakage after storage wells are completed.

Rector "RH" casing heads and Rector "ML" tubing heads are ideally suited for storage well completions, and for oil and gas wells. The Rector seal-with-steel feature gives positive metal to metal seal, the trademark of Rector's design and safety. Rector *engineering know-how* is available to solve individual problems presented by varied underground storage installations. Rector equipment meets all standards of the API and the Association of Well Head Equipment Manufacturers. Tested to 22,500 lbs. as stipulated in API test specifications.

Use "Rectorseal" to insure leakproof threaded joints and connections, and Rector cementing equipment for better cementing jobs.

Be safe . . . be sure . . . buy Rector quality! See your Rector representative or your favorite supply store now!

30 YEARS MAKING THE OIL INDUSTRY SAFER

Rector

WELL EQUIPMENT CO., INC.

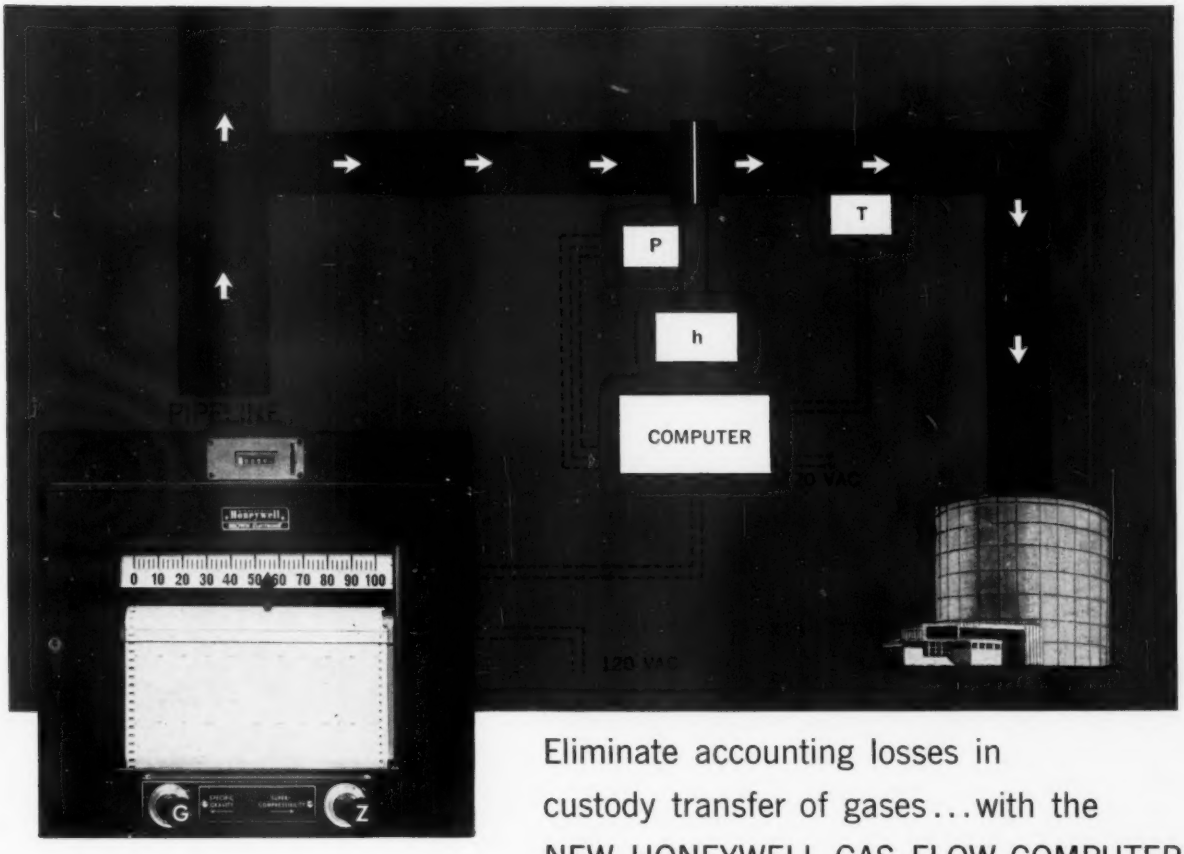
Making the Oil Industry Safer!

1100 North Commerce, Fort Worth, Texas
Houston Plant: 2215 Commerce Street

PESA PARTNERS IN PETROLEUM PROGRESS

MONOGRAMMED EQUIPMENT CERTIFICATE NO. 2158

EXPORT REPRESENTATIVES: CONTINENTAL-EMSCO CO., MID-CONTINENT SUPPLY CO., OILWELL DIVISION OF UNITED STATES STEEL CORPORATION



Eliminate accounting losses in custody transfer of gases...with the NEW HONEYWELL GAS FLOW COMPUTER

When you're selling or buying gas, even a slight inaccuracy in flow measurement can mean the loss of many dollars. Prevent this loss with the accurate, all-electric gas flow computer. It measures, records, and totalizes *mass rate* of gas flow, automatically and continuously. Temperature and pressure variations are compensated for automatically—eliminating the inaccuracies of "averaging" and other methods of computation.

The gas flow computer does away with tedious, time-consuming calculations and the possibility of human error. In most applications, it will perform with accuracy of $\pm 1\%$, and, under ideal conditions, with accuracy of $\pm \frac{1}{2}\%$. You can use this new computer to measure mass flow of natural gas, propane, butane and other hydrocarbons. And you can easily link it to telemetering and remote control systems, supervisory control, data handling, and industrial process computers. Cost of the computer in most installations runs less than $4000.

Get complete details from your nearby Honeywell field engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

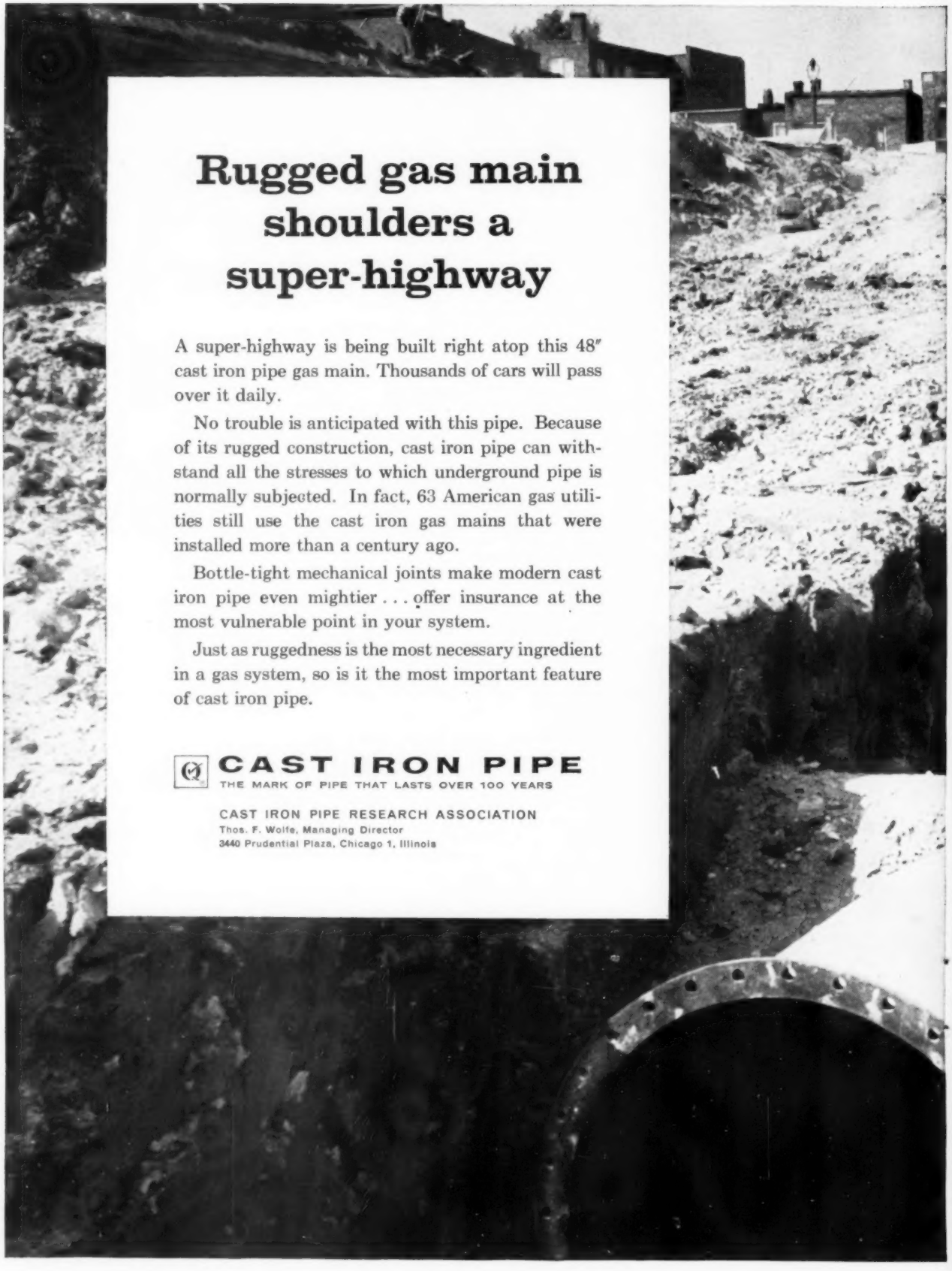
Here's how the Honeywell gas flow computer solves a gas flow equation:

$$Q = K\sqrt{\frac{hP}{TGZ}}$$

Where **Q** = mass rate of flow, scfh
h = differential pressure, inches of water
P = static pressure, psia
T = flowing temperature, °R, (°F + 460)
G = specific gravity
Z = super-compressibility
K = orifice flow constant

The *ElectriK Tel-O-Set* △P/I transmitter measures *h*; an absolute pressure transducer measures *P*; and a resistance thermometer bulb measures *T*. The analog computer multiplies *h* by *P* and divides by *T* . . . and sends a resultant millivoltage to the *ElectroniK* recorder. The recorder applies the correction factors G and *Z*, extracts the square root, and records the resultant mass flow Q.

Honeywell
First in Control
SINCE 1885



Rugged gas main shoulders a super-highway

A super-highway is being built right atop this 48″ cast iron pipe gas main. Thousands of cars will pass over it daily.

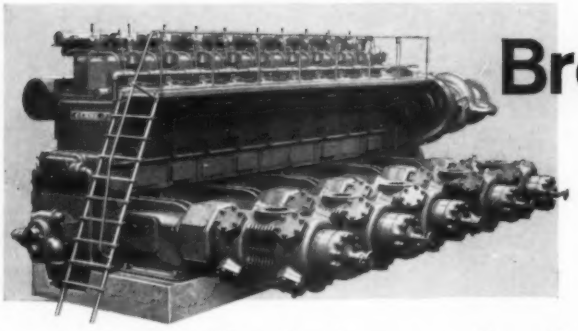
No trouble is anticipated with this pipe. Because of its rugged construction, cast iron pipe can withstand all the stresses to which underground pipe is normally subjected. In fact, 63 American gas utilities still use the cast iron gas mains that were installed more than a century ago.

Bottle-tight mechanical joints make modern cast iron pipe even mightier . . . offer insurance at the most vulnerable point in your system.

Just as ruggedness is the most necessary ingredient in a gas system, so is it the most important feature of cast iron pipe.

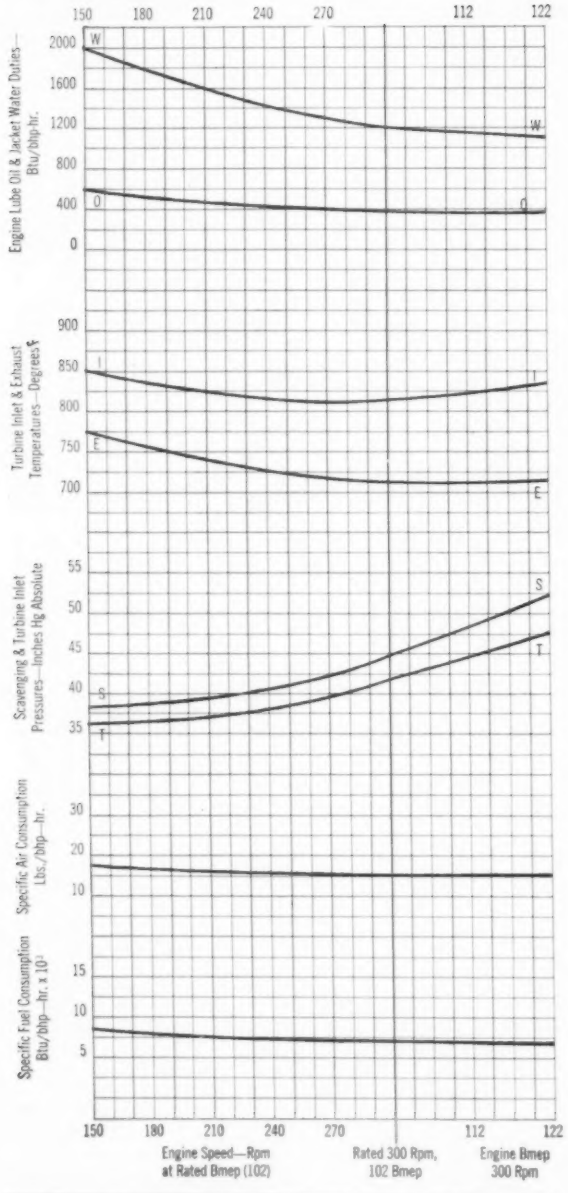
CAST IRON PIPE
THE MARK OF PIPE THAT LASTS OVER 100 YEARS

CAST IRON PIPE RESEARCH ASSOCIATION
Thos. F. Wolfe, Managing Director
3440 Prudential Plaza, Chicago 1, Illinois



Breakthrough in two variable speed,

Automatic ignition timing plus automatic turbocharger control provide unrivaled speed, load and response characteristics.


150 180 210 240 270 112 122
Engine Lube Oil & Jacket Water Duties—Btu/bhp-hr.
2000 1600 1200 800 400 0
W
O
Turbine Inlet & Exhaust Temperatures—Degrees F
900 850 800 750 700
I
E
Scavenging & Turbine Inlet Pressures—Inches Hg Absolute
55 50 45 40 35
S
T
Specific Air Consumption Lbs./bhp—hr.
30 20 10
Specific Fuel Consumption Btu/bhp—hr. x 10³
15 10 5
150 180 210 240 270 112 122
Engine Speed—Rpm at Rated Bmep (102)
Rated 300 Rpm, 102 Bmep
Engine Bmep 300 Rpm

Performance curve of Clark Model TLA turbocharged, 2-cycle, gas-engine-driven compressor. Unit features 17"x19" bore and stroke. Rated speed is 300 rpm. Rated bmep is 102 psi. Note the remarkable parallel between the fuel consumption and specific air consumption curves.

Q. What makes two cycle engines so well suited for variable-speed, variable-load applications?

A. It has long been traditional to consider two cycle engines as good prime movers for applications where power and speed are maintained close to 100% of rated load and speed. This may have been true a number of years ago when two cycle engines were single and twin horizontal designs. But the situation began to change with the introduction of vertical, multicylinder machines with direct fuel injection. Subsequent addition of constant pressure turbocharging and automatic ignition timing control have made two cycle performance equal or superior to four cycle engines in acceleration and in response to load or speed changes. Regardless of how fast the load or speed changes, the two cycle engine is able to adjust more rapidly because it fires twice as frequently. As a result the actual amount of load change between successive firings is cut in half, all other conditions being equal.

Q. Why has turbocharging caused such a vast improvement in two cycle engines?

A. The Clark system of constant pressure turbocharging permits variation of scavenging air flow with load to maintain relatively uniform air/fuel ratios over the complete operating range. This variable air supply plus maintenance of optimum ignition timing enables Clark engines to achieve excellent performance from substantial temporary overloads at rated speed down to the usually recommended 50% speed at constant torque.

Q. Why is constant pressure turbocharging so effective?

A. In general, all turbocharged engines are arranged to achieve best efficiency and fuel consumption at a particular design point—usually rated load. The Clark system of constant pressure turbocharging, however, is inherently capable of maintaining optimum efficiency not only at design point, but over an extremely broad operating range as well. The reason: *Clark turbocharging provides a flexible supply of combustion air that varies in direct proportion to load.* It does not depend on pulses of exhaust gas or on engine driven blowers, hence is free to provide the exact amount of air demanded by the engine. At light loads, there is neither a fall-off in performance nor any "lean out" problem arising from too much air. With increased loads, the turbocharger is able to pump increasingly more dense scavenging air into the power cylinders. There is no element in the

cycle compressor performance for variable load applications

system to impede or interfere with the performance of the turbocharger as it responds to the higher power requirements. Thus the fuel/air ratio remains constant through the entire operating range for best engine performance.

Q. Are there other important advantages of the Clark Constant Pressure Turbocharging system?

A. Yes. In addition to efficient combustion, the large amounts of available scavenging air have a cooling effect on the cylinder walls, cylinder heads and piston heads. Possibility of detonation is minimized, better lubrication is assured, and the temperatures of the exhaust gases are controlled as they enter the turbocharger. The cooling effect of the excess scavenging air is especially advantageous at high ambient temperatures. It lowers overall cooling duty and enables the Clark intercoolers to provide adequate scavenging air cooling. There is no need to resort to evaporative cooling of air or other special means of preventing detonation and cylinder wear.

Q. How does Clark achieve such good low speed lugging characteristics?

A. With Clark turbocharged, two cycle engines, compressor capacity can be most easily and efficiently varied by adjusting speed while maintaining at or near rated load torque. *The engine-driven compressor is then operating at rated load all the time, at which condition it functions most efficiently.* The exceptional low speed lugging characteristics are due primarily to frequent power impulses that reduce cyclic speed variation. At low speeds, cyclic speed variation is always accentuated because flywheel inertia is reduced in proportion to the square of speed reduction, and power impulses become less frequent with respect to time. Thus the two cycle engine has a great advantage because each cylinder fires every revolution.

Q. How do Clark two-cycle engines perform under overload conditions?

A. A glance at the chart showing actual test data taken from a Clark turbocharged Model TLA gas-engine-driven compressor demonstrates graphically that the fuel consumption curve is remarkably flat over a wide range. When operating as high as 20% overload under emergency conditions, Clark engines actually burn *less* fuel per bhp than at rated load. Even more important is the manner in which the specific air and specific fuel consumption curves parallel each other perfectly over the entire range. This illustrates the inherent advantage of Clark "true" turbocharging system. Once the engine is started and the turbine is self-sustaining, the turbocharger adjusts itself freely and almost instantaneously to the demands of the engine.

Q. How does ignition timing control improve operating performance?

A. There are two conditions in which ignition timing control is used with the Clark system: At startup and at reduced speeds. During the starting cycle, the timing control automatically adjusts the ignition to increase the flow of heat to the turbocharger. This shortens startup time and substantially reduces consumption of starting air.

At reduced speeds (i.e. from 50% to 80% rated speed), the ignition is automatically regulated to maintain optimum ignition timing consistent with the rate of pressure rise in the cylinder with respect to time. Thus the peak pressure is reached at or near top dead center and expansion of the burned gases takes place most effectively with less tendency to detonation.

Q. What is the net effect of combining turbocharging with two-cycle engines?

A. The user enjoys all the advantages of a two-cycle engine —simplicity, fewer moving parts, greater dependability— plus the advantage of turbocharging—more power in less space, better fuel economy, greater operating flexibility. Clark two-cycle gas-engine-driven compressors are very conservatively rated. Lower bmep eliminates the ignition difficulties and fouling tendencies common in higher rated machines. There are no large exhaust or intake valves to warp, pit or burn. Two-cycle design keeps continuous downward pressure on the power pistons, thereby eliminating oil "pumping." There is no piston ring blowby, the cause of sludging and crankcase oil dilution. The two-cycle engine is less sensitive to detonation under high ambient temperatures. Thus Clark design reduces costly maintenance and assures more profitable "uptime."

Q. In what type of application is Clark capacity variation with speed useful?

A. Pipeline gas transmission where there are few units in a station. Process applications employing gas engine drivers. Gas distribution boosters where the compressors are located near sales outlets. Manufactured gas compressors. Field gathering compressors where few units can be economically employed and wide variation in gas supply is expected.

For more details on how Clark variable-speed, variable-load performance can help you, contact your nearest Clark office or write to:

CLARK BROS. CO., OLEAN, N. Y.

a NEW shape*...

* . . . for the "business end" of the Gas Business!

In a MODERN NEW PLANT we now are producing the new ***Arkla V-250 Gas Meter.*** *Efficient, compact and streamlined, this new meter is built for long life. Aluminum parts are specially treated against corrosion. Two coats of enamel are baked on the exterior—exclusive with the* ***Arkla V-250!***

Tested and proven before shipping, the ***Arkla V-250 Gas Meter*** *is ready to go to work for you at the business end of the gas business—the customer service line.*

ARKLA

ORDER ARKLA V-250 GAS METERS TODAY—*Write, wire or phone:*

ARKLA METERS Russellville Ark., Ph. WOodlawn 7-2660

A Division of Arkla Air Conditioning Corporation

HOMESTEAD® LUBRICATED PLUG VALVES

They keep right on working when ordinary valves have to be replaced. Why? For several reasons. First, because of very close tolerances between sealing surfaces of the plug and body (.002″ clearance on small sizes, and .005″ to .007″ on the largest sizes). Second, because of their *controlled* pressurized lubrication system which guarantees complete coverage of all sealing surfaces, provides chemical seal against leakage and protection against corrosion. Add to these the positive plug-freeing action which occurs with each lubrication, and it's easy to see why Homestead Lubricated Valves last. Get the complete story. Send for Reference Book 39-1; and for the assurance that quality brings, specify Homestead Lubricated Plug Valves.

hv

HOMESTEAD VALVE MANUFACTURING COMPANY

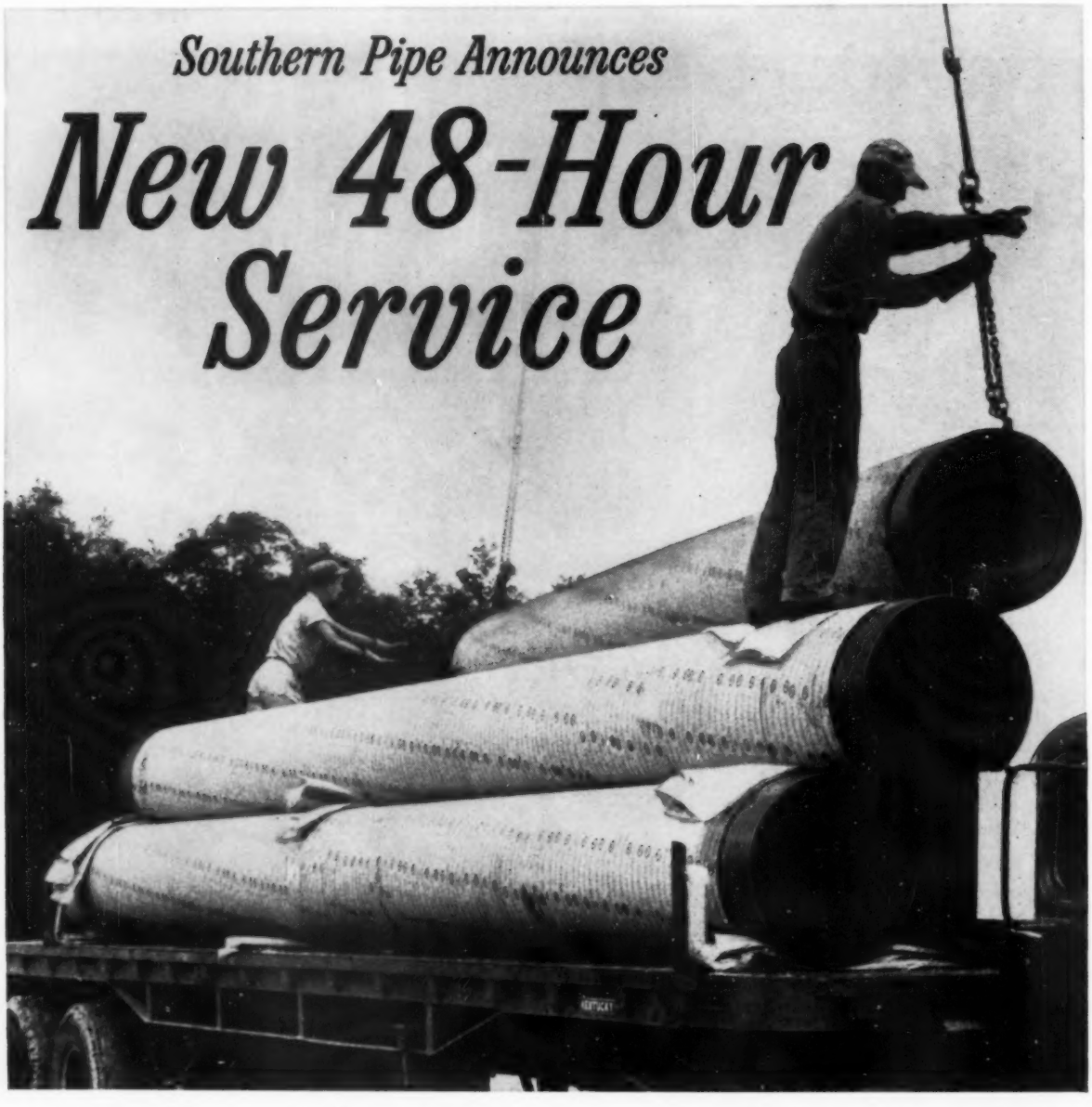
"Serving since 1892"

P. O. Box 405, Coraopolis, Pennsylvania

Makers of: Homestead Ball Valves, Cam-Seald, Lever-Seald and Lubricated Plug Valves.

Southern Pipe Announces

New 48-Hour Service



including delivery to your site by our trucks!

From the Southeast's largest, most modern pipe protection plant now comes faster service than ever! Within 48 hours of the time we get your order, our own truck fleet will deliver the pipe, coated, wrapped and lined to specifications, right to your job site.

Our new all-weather automatic production lines now handle pipe up to 30″ in diameter and include special facilities for coating, wrapping and lining larger pipe up to 80″ in diameter—all to your exact specifications. Southern also offers free stringing along passable roads to reduce handling costs and minimize risk of damage. If you wish, you may store your bare or finished pipe in our 24-acre plant at no cost to you.

For the best pipe protection available, including performance-proved Coal Tar Enamel . . . specify Southern, in Atlanta, Georgia.

Southern Pipe Coating Company

795 PEACHTREE STREET, N. E. *ATLANTA, GA.*

Is water a problem in your gas storage field? This National Supply wellhead installed by Citizens Gas and Coke Utility near Indianapolis furnishes complete control of the well, with water blow off tubing in or out of the hole.

Why you find National Supply Wellheads installed in the important gas storage fields

COMPLETE CONTROL of the well, with or without tubing in the hole, is assured with this National Supply wellhead installed in the Linton field of the Citizens Gas and Coke Utility in Indiana.

This complete control is achieved with standard wellhead components available in the National line.

Pressures in the Linton field are 800 psi with wells going to about 2,000 feet. When the field is completed, there will be about 12 storage wells in operation.

You usually find National Supply wellheads at installations such as this Linton field. One important reason is that National Supply manufactures a *complete* line of advanced wellhead assemblies and has the staff to service this equipment in the field. When standard units do not meet your requirements, National Supply can define your needs, recommend the proper units and build them to meet the toughest specifications.

Next time you buy wellheads, be sure to investigate the many advantages of National Supply units. For complete information, call your store, or write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pa.

Steel's Symbol of strength, long life, and economy

ARMCO National Supply Division

NOW YOU CAN GET B&W LIGHT WALL GAS DISTRIBUTION FITTINGS

Definite cost-cutting advantages can be yours thru the use of light wall piping for your low-pressure gas distribution systems. The material cost is less. Shipping and handling costs are less. Fabrication and installation cost is less.

B&W, at their new Welding Fittings plant in Beaver Falls is now producing a complete line of lightweight fittings and flanges for non-critical piping. They are available from stock in sizes from 4″ thru 24″. For further information and a complete list of sizes and dimensional data, write for B&W bulletin TF-505 or contact any B&W District Sales Office.

The Babcock & Wilcox Company, Tubular Products Division, Fittings Plant, P.O. Box 230, Beaver Falls, Pennsylvania.

B&W THE BABCOCK & WILCOX COMPANY

TA-1018 WF 1

TUBULAR PRODUCTS DIVISION

Seamless and welded tubular products, solid extrusions, rolled rings, seamless welding fittings and forged steel flanges — in carbon, alloy and stainless steels and special metals

Why drill services?
PUNCH 'em!

This product covered by Patent No. 2,950,637 —other patents pending

← Four small guides which hold punch to its true axis.

For taking services off mains. A quick, safe, steel (shell casting) welding tee that incorporates in each tee a punch and positive shut-off. Does away entirely with drill devices. We also have a model threaded at the base to screw into the saddle.

Punches. ¼", 5/16" and ⅜" diameter, recommended for 5/16" (or thinner) pipe wall thickness. ½" diameter, restricted to use on ¼" wall thickness or thinner.

Each tee is tested to 5,000 p.s.i. hydraulic pressure, and carries "Rated 1,000 pounds". A 5 to 1 safety factor. Made from steel similar to pipe, it welds easily, and in the saddle model, takes a perfect thread.

Both sizes made have 1" base. Side outlet can be furnished ¾" or 1", end beveled for welding, standard pipe size, either threaded, or smooth for compression coupling. Or outlet can be internally threaded for ½" pipe size.

With this tee you will be forever free from the cost of drilling machines, broken drills and drill machine maintenance and repairs. We feel this tee is the finest service improvement ever offered to the gas industry. Write for circular with installation instructions.

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA

SKINNER-SEAL PUNCH-IT TEE

What you get from
GLAMORGAN
with
GP-MARLEX®
Engineered
gas pipe

EXPERIENCE. Glamorgan Plastics is a division of Glamorgan Pipe & Foundry Company, a leader in pipe manufacture for over 75 years.

QUALITY. Glamorgan's modern new pipe extrusion plant, quality testing laboratories, and experienced personnel combine to bring you superior pipe extruded from Marlex* resin conforming to the highest standards for smooth surfaces, precise dimensional shape, concentricity, and impact strength.

SERVICE. Glamorgan's Technical Service Department smooths out all problems by bringing expert knowledge to your specific application of GP-Marlex* *Engineered* gas pipe.

ECONOMY. *Engineered* gas pipe produced from Marlex* resin costs less to handle, install, and maintain. It is easily cut with a common hand saw and fusion joined with a simple, inexpensive device. Installation costs will be cut drastically.

SATISFACTION. Pipe of Marlex* resin won't rust or rot; takes hard usage even in cold climates. Smooth inside walls boost flow rates substantially.

A complete service from Glamorgan. Send for technical and descriptive information.

gp
glamorgan plastics
A Division of Glamorgan Pipe & Foundry Co
LYNCHBURG, VIRGINIA

*A trademark for Phillips family of olefin polymers.

Washington • *Cont'd.*

from page 20

In addition, the lawmakers provided the President with an extra 100,000 government-subsidized public housing units for low-income families.

And it also approved $2 billion in federal grants for slum clearance and urban renewal projects. Added to that is $500 million in federal loans to help finance construction of sewer and water and other public facilities.

To ice the cake, the legislators granted $1.2 billion in federal loans to colleges for new dormitories.

All of these programs can mean new gas connections and appliance sales.

But they also will mean either higher taxes, or more inflation, as the country foots the bill for its luxuries. ■

corrosion • *Continued*

from page 23

measurements which are on record. Actually, if we had available instrumentation which would give us one more place — accuracies of one microvolt — the consistency test of field measurements would probably justify its use. In general, it can be said that line current measurements are much more satisfactory, much more consistent, and conform much more closely to theory than do those of pipe-to-soil potential. If they could only be taken with simpler arrangements than the presently required multiple test leads — or if owners could be readily persuaded to make the additional installations needed — then the task of making the current and potentials encountered along a pipeline conform with a consistent mathematical theory would be much easier; and with this accomplishment would come the much more important one of making the prediction of what is going to happen next, insofar as corrosion is concerned, and just when and how fast it is going to happen, also much easier and more reliable; and this is something which is well worth working towards. ■

Light, strong, non-corroding . . . plastic pipe made of High Density MARLEX*

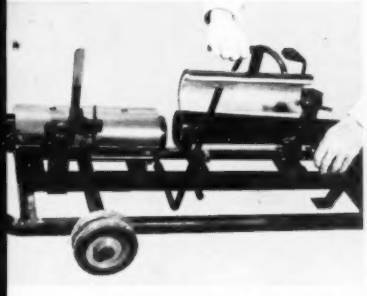
Low cost, more economical installation, and long service life are big reasons for the increased use of coilable and straight lengths of MARLEX pipe for gas distribution, crude oil lead lines, gas and crude gathering, salt water disposal, supply lines for gas pump engines, and the like. For example, 2-inch Schedule 40 MARLEX pipe costs less than equivalent steel pipe . . . will not corrode or scale up . . . and, since it weighs about ⅛ as much, is more economical to ship, handle, and install. Even the larger diameter MARLEX pipes can be handled without hoists, side-boom cats, or other heavy equipment.

No other type of pipe is as tough, durable and easy to use as pipe made of MARLEX TR-212 (ASTM Type 3 Polyethylene classification). It has good load bearing characteristics, a wide usable temperature range, and is virtually indestructible . . . resists acids, solvents, alkalies, bacteria, rot, and fungi.

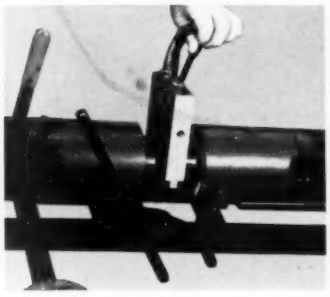
For samples and details on MARLEX pipe, see your pipe supplier . . . or contact us directly.

*MARLEX is a trademark for Phillips family of olefin polymers.

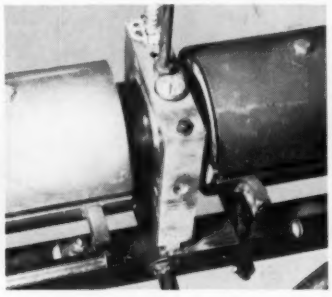
Low-Cost, Butt Fusion Makes Strong Joints Quickly and Simply!



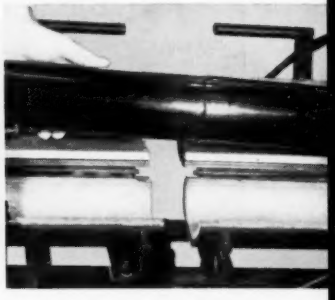
Pipe or conduit is clamped in portable fusion rig.



Thermostatically controlled heating plate is inserted.



Ends to be joined are heated in a matter of seconds.



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Upper Photo: Central station readout is provided by digital indicators on the schematic panels at left and on typewritten sheets from the data logger at far right. Control signals are telemetered digitally from the operator's console shown in center of picture.

Lower Left Photo: Metering and regulating station variables are monitored by Bristol gas flow computers and Dyna-Servo static pressure, temperature and differential pressure transducers. Use of conventional pneumatic controllers and diaphram valves is made possible by Dynamaster® digital-to-analog transducers (at center and right of panel) which convert the telemetered binary bit signals into pneumatic regulator set points. **Lower Right Photo:** These Bristol Metagraphic controllers operate pneumatic regulator valves through conventional 3-15 psi control signals. All valve positions are controlled by digital commands from the central dispatch office.

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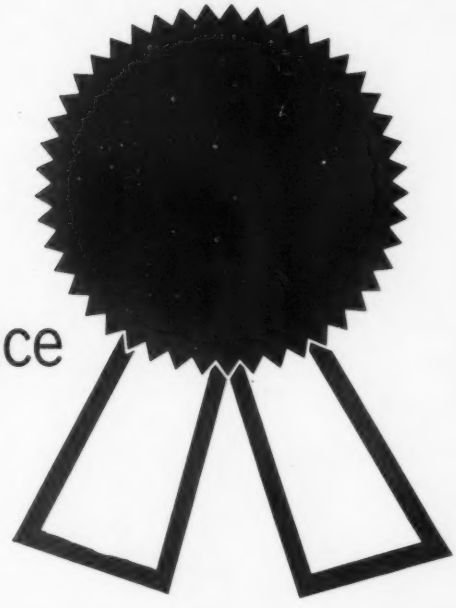
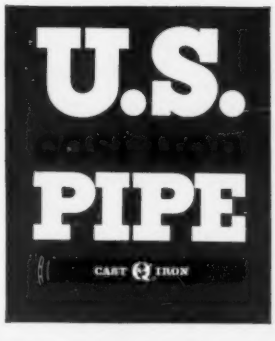


so does this



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GAS

AUGUST 1961

from CANADA TO CALIFORNIA

Pacific Gas & Electric builds a line

By J. FRED EBDON • Editor

DOWN a long and at places tortuous trail, a mighty steel conduit is being muscled and machined from the west-central part of Alberta, Canada, to near San Francisco, U. S. A. It will be used to transport energy—energy in the form of natural gas.

Target for the 36-in. gas pipeline, and market for energy it will transmit, are the fairest cosmopolite among U. S. cities—San Francisco, Calif.—its halo of surrounding Bay area communities, and the populous of Central and Northern California. This California area has both natural gas and electric utility service well rendered by Pacific Gas & Electric Co.

Though headquartered in beautiful, majestic San Francisco, Pacific Gas & Electric Co. does not have a service area limited thereto. Quite the contrary is true. The company's energy systems reach out to bring private utility service to 47 California counties with an estimated population of 6,750,000 people. This represents some 94,000 square miles of territory. It also represents the largest geographical service area of any utility in the state.

Pacific Gas & Electric also has some water and steam utility operations; however, these are of a relatively minor significance in comparison with its vast natural gas and electricity operations.

Our subject company is big—very big. But Pacific Gas & Electric is not content to let its record of service be judged by largeness. It is keenly aware of its public service obligation and the major role its operations play in the social and economic life of Northern and Central California.

PG&E has seen fast growth and has expanded its

TABLE 1. PG&E'S ESTIMATED CUSTOMER GROWTH—1961

Gas Customers			Electric Customers		
Jan. 1, 1961	Gain in '61	Jan. 1, 1962	Jan. 1, 1961	Gain in '61	Jan. 1, 1962
1,690,523	59,000*	1,749,523	1,977,000	60,000*	2,037,000
		Total Customers (1-1-61)	3,693,000**		
		Total Customers (1-1-62)	3,812,000**		

*Estimated
**Includes gas, electric, water and/or steam customers

systems to keep gas and electric facilities ahead of this evolution. For this, more than $2.9 *billion* have been invested in gas, electric, water, and steam plants. And with the close of the 15-month period ending Dec. 31, 1961, an additional $500 million will have been invested in new gas and electric facilities. The statistics of *Table 1* amply show the reason why.

The big San Francisco-based company does not serve gas and electricity to each and every area or community within its service territory. There are gas and electric service areas; gas only service areas; and electric only service areas. In its 47-county area, PG&E serves gas in 33 of these, 46 counties have electric service from this company, and the 47th county is served with gas only. But increasingly, natural gas becomes involved with any and all customers—for electricity or gas service—connected to Pacific Gas & Electric's systems.

PG&E's gross system electric output for 1960 climbed over previous figures to hit 28.8 billion kw-hr. This power was produced in hydroelectric, steam, nuclear, and geothermal generating plants. Some 64.4 per cent of these kilowatt-hours were the product of steam plants during 1960—an exceptionally below-normal year for precipitation. The steam plants can be fired with either natural gas or fuel oil. During 1960, Pacific Gas & Electric transmitted over 140 billion cu ft of natural gas to its own steam plants to generate electricity for Northern and Central California.

Additional power generating facilities of the four types are planned and being built. An addition is planned for the Geysers plant where 12,500 kw is generated from natural steam. It is the first of its type in America. Too, a 60,000 kw Humboldt Bay nuclear power plant—a uranium-fueled boiling water plant that will pioneer the pressure suppression containment principle—is under construction. Hydro plants likewise continue to be built, and steam plants and additions are also under construction.

But, Pacific Gas & Electric's predominantly hydro source for electric resources in years past has undergone a metamorphosis to principal reliance on thermal sources. This trend seems destined to continue for many years. Hence, natural gas looms ever more important in the company's total electrical operations, and is overwhelmingly prime in its gas service operations.

The Pacific Gas & Electric systems—serving a growing population which shows a trend of increasing requirements for gas and electric energy—supply the impetus for one of the most dramatic construction projects in recent years. This huge undertaking is the Alberta-California natural gas pipeline which is linking gas fields in the eastern foothills of the Canadian Rockies with the Golden Gate. It ties-in PG&E's future energy requirements with prolific and high-potential gas fields in Canada. To a demanding market area, it will bring an entirely new major source of natural gas.

HISTORY OF PACIFIC GAS & ELECTRIC CO.

Argonauts by the thousands streamed into California during the gold rush era. When fast fortune offered by the soft but sought mineral eluded most of them, many quickly lost heart. Some merely faded into the scenery of the country. Some beat their way home poorer and perhaps wiser.

Others, however, stayed to build a new life in the vast, untouched treasure of California. These stayers were the empire builders. These were the flexible people who, on failure to obtain the goal of gold, quickly focused foresight on a potential. These were the people who saw a future for this Pacific Coast land. They liked what they saw and were determined to build a life, fortune and permanent home in California.

These were the men poet Sam Walter Foss was looking for with his words from "Coming American" —now graven in stone over the entrance to the California State Office Building in Sacramento—"*Bring Me Men to Match My Mountains.*"

An American-built steamship, the S. S. "*Oregon,*" sailing from Callao, Peru, cleared the Golden Gate, and dropped its hook in San Francisco Bay in June of 1849. Its engineer, Peter Donahue, 27 years of age, came ashore. He was really on a "new frontier."

He came looking for gold. He found little enough. But he stayed on in the muddy darkness of San Francisco, and he had lots of vision.

After trying his luck at gold mining along the American river, he heard that his brother James was in San Francisco, and returned and found him. They formed the Union Iron & Brass Foundry in the Bay city. It prospered. A third brother, Michael, joined them in the venture.

Though he was a business success, Peter Donahue had faith and vision that extended far beyond the scope of San Francisco of the 1850's. He is quoted as once saying: "Give me the privilege of supplying this city with gas and I care not for any other fortune."

He, his brothers, and associates did just that. Although in concert this group knew little or nothing about making gas, selling it, distributing it, or the utility business in general; they overcame many ob-

stacles and started a gas company and system.

Their San Francisco Gas Co. started operations on Feb. 11, 1854. It was the first gas utility in all the West. Gas lights were the new company's base and only load. Its fuel helped light the way for San Francisco's citizens to travel the muddy sidewalks and wade through street crossings. And it was remarked that when the streets became more generally lighted with gas lamps (only 84 shone forth the first evening), the city could expect less frequent midnight robberies and murders.

Gas lighting caught on fast in San Francisco. The customer count went up; the initial price for gas ($15/Mcf) went down. San Francisco Gas Co. grew.

Sendout was coal gas. Australian coal was laid down at the gas company's tidewater plant. Most plant and system equipment was brought from the East. The company played a really pioneering role; everything it did was a first for the area, and men with technology in gas were almost non-existent on the West Coast.

Gas lighting continued to spread through San Francisco and the Donahue brothers' little gas company made progress and profit. Inevitably, others moved in to try for some of the fortune that was falling to the pioneering gas company.

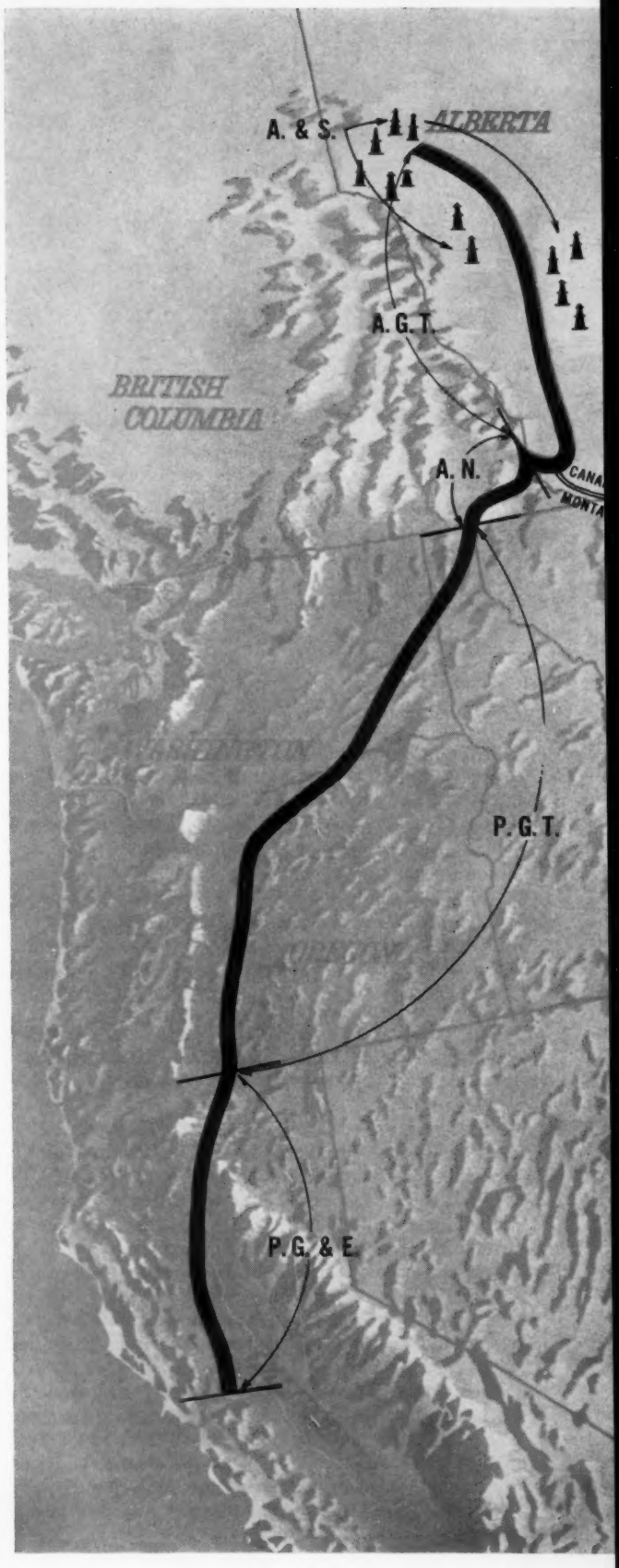
The consuming public in those gas-light days failed to understand the principles of gas utility (or any utility operation, for that matter) operations, even as they do today. Thus, as new gas companies were formed, any and all were given franchises. Current philosophy was the more gas companies a city could get into operation, the lower gas rates would be.

This turned out to be true, but it resulted in impossibly tortured streets, decline of service, and a general path to bankruptcy for any and all who entered the price-cutting gas-fight arena. Thus, San Francisco Gas Co. fought, bought, and merged with competing gas companies to become San Francisco Gas Light Co. in 1873.

Still gas wars continued. And a still greater competitor was moving into the Bay area—the electric light. This did not daunt other communities not wanting to be outshone by the gas lights of San Francisco.

Sacramento, built just below Capt. Sutter's historic fort at the confluence of the American and Sacramento rivers, got a gas plant and lights in 1855. Marysville got gas in 1858; Stockton in 1859; San Jose in 1860; Oakland in 1866; and so it was in Nevada City, Grass Valley, Vallejo, and Napa—the 10th California city to get gas lighting.

Stockton is worthy of mention because workmen there, while drilling a water well in 1864, hit a natural gas reservoir. Natural gas was then piped to various places in and around the community. This marked the first useful application and utilization of natural gas in all the West.



KEY

A. & S. = Alberta & Southern Gas Co. Ltd.
A. G. T. = Alberta Gas Trunk Line Co. Ltd.
A. N. = Alberta Natural Gas Co.
P. G. T. = Pacific Gas Transmission Co.
P. G. & E. = Pacific Gas & Electric Co.

NEAR RIGHT: Cold weather work on the 30-in. mainline near the Windfall lateral. Stringing truck gets assist from tractor to take steep grades on icy access road. Such work, along with clearing and grading river crossings, made good progress through the Canadian winter (Sch. IV, AGTL, Alberta). FAR RIGHT: Typical muskeg —bog over-grown with several varieties of moss—country up in Alberta near the start of the 30-in. mainline. Here, pipe gang is lining up on contractor-built ROW road, consisting of heavy rip-rapping with muskeg and earth dozed on top. Miles and miles of this type of road had to be made for ROW and access (Sch. IV, AGTL).

The San Jose gas development is also of significance. There, the Garden City Gas Co., a late arriving competitor to the pioneering San Jose Gas Co., first introduced the Lowe water-gas process to the Pacific Coast. This process had a profound effect on the West Coast gas business.

The pattern for gas utilities in northern California was set. First, a small company would spring up in a market and pioneer introduction of gas. Then, competing gas companies would be formed. Gas wars would set in. At last, the competing companies would merge to prevent the ruin of all. A last step was left to be taken. That was merger with electric companies.

Electricity in San Francisco

San Francisco was the first city in the United States to have central generating facilities with distribution of electricity to non-associated customers. It was probably the first city in all the world to have such service, so far as can be determined. Electric service started there in June 1879 by the California Electric Light Co. The man of vision was George H. Roe.

Like his gas industry counterpart, Peter Donahue, who started California's first gas utility, Roe knew not one thing about the technical or any other side of the electric business when he started California's, and perhaps the world's, first electric utility. Surely, a lesson is there for the technical and highly specialized young people of today who yearn for great accomplishments.

George Roe also was a man to match the mountains. He and associates overcame problems and difficulties that would stop many a man today. Their small generating plant did, however, get into operation. Electric lights started to overpower gas lights in the public favor. The utility began to grow. It was not a too-swift process.

California Electric Light Co. operated with Brush arc-light dynamos and Brush lamps. While Thomas A. Edison had given the world the first incandescent lamp in late 1879, it took a few years for it to migrate to the Pacific Coast in commercial quantities. Thus, California Electric was able to stave off competition and survive until 1891.

In mid-1890, the inevitable trek of the Edison incandescent lamp started to the West Coast under the management of The Edison General Electric Company of New York, which had full rights to the inventor's patents. George Roe recognized the unavoidable and arranged negotiations whereby the Edison Light & Power Co. emerged.

Edison Light & Power too found competition in numbers. It purchased and merged in the same fashion as the gas industry of northern California. Also, like the pioneering gas industry, power plants and electric lights slowly spread to other communities in Northern California.

So it was that two major utilities emerged in San Francisco; (1) San Francisco Gas Light Co., and (2) Edison Light & Power Co. There were others around too, to be sure, but these held dominant.

With the coming of the Edison lamp, the gasmen grew rather gloomy. However, development of the Welsbach mantle came just in time (it was brought to the U. S. in 1887) to sustain the gas industry while other utilizations of gas were experimented with and developed.

San Francisco Gas Light Co. could, however, see Edison Light and Power eventually taking the better part of its basic business. So, it felt it needed electrical operations. With this in mind it dispatched its president, Joseph B. Crockett, to Europe to inspect the very latest in electric plant, with the intention of going into the electric business.

This move, plus severe competition from several major gas and electric utilities, plus a gaggle of minor competitors in one or the other of the businesses, led to a very major consolidation. Thus, through a merger of Peter Donahue's San Francisco Gas Light Co. and George H. Roe's Edison Light & Power Co.—plus several other local utilities—there emerged San Francisco Gas & Electric Co. The date was Dec. 11, 1896.

At this point, it is well to digress to consider the part water has played in Pacific Gas & Electric's history. Again, we go back to the colorful gold mining days. The Argonauts had to have water and they had to know water. It is a prime requisite for placer mining.

As the miners worked out the streams, they found paying gravel beds some distance away. Two choices were open to them; one, take the gravel to running water, or, two, bring water to dry diggings. The latter path was usually taken. Many ditches were dug and water became almost as valuable as gold.

Naturally squabbles grew out of water rights and ditchers crossing each others' paths, so competition drew ditch builders together to form companies. Soon these water companies were building dams, lakes, reservoirs, ditches, canals, aqueducts, flumes, spillways and what have you, all through the mountains and valleys of northern California to serve surface and hydraulic mining. It was reported that in the 1860's there were over 5000 miles of artificial water courses in California—some, hundreds of miles long when branches were added. When hydraulic mining peaked, there were probably 8000 miles.

These water-for-mining companies accomplished amazing feats in dams, tunnel, pipeline, aqueduct, etc., construction as they moved vast volumes of water off mountains, across canyons and gorges, through ridges, etc., in rugged, primitive country. They did not dream that they were establishing the very close link between Pacific Gas & Electric and hydroelectric power. In fact, gold-rush men knew little about electricity at all.

For example Lester Pelten invented the Pelten wheel in California to furnish mechanical power for mining operations from the energy of falling or fast running water. Little did he dream that his device would become an important component of modern hydroelectric equipment.

As surface and hydraulic mining declined, the "ditch companies" turned to irrigation and municipal water supply. With development of man's ability to extract work from fast-running water for conversion to electric power, there was a natural evolution of water companies to or into the electric business. Some started their own electric operations; others became part of existing electric systems. In either case the key factors were the knowledge of hydraulics and existing water properties these companies had developed.

As it was with the gas and electric utilities, so it was with the hydroelectric and water companies. They too fought, purchased, were purchased, reorganized and merged from small, unstable organizations into large, stable utilities.

Thus, another important branch of PG&E's family tree developed. It started with the Little Rock Creek Ditch Co. This enterprise was organized in 1850—making it the oldest corporate entity to gravitate into the formation of Pacific Gas & Electric Co. It later was consolidated into the South Yuba Water Co., which in turn was one link in a long chain of events and consolidations that resulted in the California Gas & Electric Corp.

This company had, by the turn of the century, managed to bring under its control utility systems in Oakland, Sacramento, and a number of towns in northern California counties. But, it had no access by

1903 to San Francisco where the really big potential for its hydro power existed. This was a challenge, and it was met, producing access to an industrial market in that city.

In 1904, the situation looked like this. San Francisco Gas & Electric was dominant in the gas business. However, its electric source was completely steam plant which was relatively expensive to operate—compared to the then-vast hydroelectric development.

California Gas & Electric had hydroelectric power, but did not have an outlet to the domestic market in the largest northern-California market—San Francisco. Too, it lacked thermalelectric generating capacity which it needed when dry seasons were experienced or when water power failed for some other reason. Both companies had great strengths and some weaknesses.

It was obviously time for the two great companies to get together. Unification would mean more efficient management and operations under centralization; integration of complementary facilities for better service to people in an 89,000 square mile area; qualification of stocks and bonds for listing on the New York Stock Exchange which would further open the Eastern money markets to the western utilities; the elimination of the weaknesses of each company; and better position to meet new and powerful competition that eternally sprang up.

Through a series of very complex transactions, a new firm, Pacific Gas & Electric Company, San Francisco, came into being. On Jan. 2, 1906, it assumed control of San Francisco Gas & Electric Co. and California Gas & Electric Corp. Each of the two utilities maintained its corporate identity. But in effect, control of PG&E ascended to a group made up of California Gas & Electric men—Eugene J. de Sabla, Jr., John Martin, and Frank G. Drum—and financier N. W. Halsey whose New York investment company, N. W. Halsey & Co., had played an important part in the unification.

PG&E was just getting on its corporate feet when disaster and tragedy struck.

April 17, 1906, was a gala prelude to a catastrophic 'morrow. That evening the unmatchable Caruso was lifting his immortal voice in the fabulous Grand Opera House in San Francisco. PG&E executives and others were in the grand hall with their families. It was an affluent and cosmopolitan crowd of music lovers. Later, they and the rest of San Francisco returned to their homes and slept the good sleep of progress and security.

At six seconds after 5:12 a.m. on the morning of April 18, 1906, the first shock in a series of titanic earth movements hit the mostly sleeping, mostly peaceful city. A dozen more major shocks hit in the first hour thereafter. Thirty-one jolts were recorded before the day was out. A never-to-be-forgotten disaster had struck. Caruso never again set foot in San Francisco.

As the earthquake hit, the city's buildings performed a weird ballet as they twisted, rocked, and collapsed. Fire almost immediately added to the terror. Five days later, when the last major fire was out, some four square miles of San Francisco's business and residential district had been essentially totally destroyed. The remainder of the city had suffered serious damage.

RIGHT TOP: Still in Alberta, but down the line past Calgary to near Lundbreck; here about where the photographer is standing, the 16-in. Canadian-Montana branch ties in with the 36-in mainline. Shown are the trench and strung 16-in. pipe as the branch takes off through real scenery heading for the Canadian-U. S. border and the Montana Power Co. (Sch. I, AGTL). BELOW RIGHT: Another example of Canadian winter work as we move, pictorially, down the pipeline towards California. Here, powdermen tamp home explosive in shot holes drilled through ice covering the Northern Saskatchewan river in through ice covering the North Saskatchewan river in spring breakup (Sch. III, AGTL).

Details of the general situation are available elsewhere. Perhaps a brief view of what faced gas utility men will be of interest.

San Francisco Gas & Electric Co. facilities were devastated. All but two of its gas and power plants were put out of service. Gas mains were ruptured, moved out of place, crushed, filled with water, etc. This was not the case in just one section or a few miles. Rather, many miles of distribution system were rent asunder. While gas service was almost immediately shut off by closing valves at the holders, miles of main holding gas remained in the rubble of the city.

To make matters worse, house piping was in as bad shape. Chandeliers were askew or down. And the same can be said of wall-mounted gas jets and gas lights. In short, the whole central part of the gas system was in a nearly complete shambles. Further, communications were disrupted; little or no transportation was available; tools, material and equipment were very scarce; and confusion was pretty general.

Adding to the job for the gas and electric utilities, the central offices of Pacific Gas & Electric, and its operating companies, San Francisco Gas & Electric and California Gas & Electric, were all ravished by both earthquake and the later fire that spread through them. This meant that all operational records and maps were lost. It also meant that there were no physical headquarters in which to even start the gigantic task of damage evaluation and reconstruction.

Electric facilities had also been badly torn up or destroyed. Probably they were in worse shape because more of an electrical distribution system is located above ground.

In the best tradition of investor-owned utility service, gas and electric crews were on the job almost before the temblors from the first sharp shock had dissipated. There is no doubt but that their action —without waiting for specific orders—delayed or reduced further spread of the huge holocaust. Many PG&E system men were on the job even while the earth was shaking.

Restoration of gas and electric service started immediately. That they were accomplished at all in the rubble-strewn city is a lasting tribute to utility-crew skill, determination, make-do, and innovation. It would be years before the systems returned to their for-

mer efficiency. In the gas system, for example, though meaningful service was restored in May of the same year, for many months fully one-third of the sendout was lost through leakage.

The economic life of PG&E, along with that of most individuals and concerns, was also seriously disrupted. Funds were needed for payrolls, equipment, repair and construction. Emergency funds were borrowed from here and there—$150,000 from one source, $300,000 from another, etc—in a hand-to-mouth manner. Bills owed the company for services were often uncollectible since many families and companies were left absolutely penniless by the event. It looked as if Pacific Gas & Electric would be forced into a receivership. But the board of directors said: "There will be no receivership," and there was none. Through a stock assessment and with business wisdom, the company was led through troubled years after the earthquake. However, the years thereafter through 1909 were a pretty tight squeeze.

Even after 1909, however, financing the needs and expansions of PG&E remained a problem. Frank G. Drum, president from July 1907 through July 1920, devoted a lot of time to the company's financial structure. He was a developer rather than a promoter. By 1913 he had reached a conclusion that the financial structure of the San Francisco utility was too heavy in senior securities (bonds) and not heavy enough in equity debt (stock).

Drum and August F. Hockenbeamer—who would one day be president—discussed the situation and came up with a very important concept for generation of utility capital. They developed what has come to be known as the "customer ownership plan." This was previously unheard of in the utility business of the U. S. It was a simple direct over-the-counter sale of PG&E stock from the company's treasury to the public.

During the issue, the mutual interest of customers and management in Pacific Gas & Electric's future progress was stressed. Advantages were pointed out for consumers to become part owners of the utility that served them. Customers and employees could even purchase shares on the installment plan!

Thus, Pacific Gas & Electric pioneered this concept that resulted in essentially public ownership of utilities all over the country.

Ever since that 1914 customer-ownership move, Pacific Gas and Electric has had a policy of encouraging local (in-California) ownership of its stock. The result of the policy established by the Messrs. Drum and Hockenbeamer is that PG&E is the most widely owned gas and electric utility in the United States. And fully two-thirds of its stockholders have addresses in California.

At the close of 1960, PG&E had over a quarter of a million stockholders among the public. In addition, almost 12,000 employees own their company's common stock.

Through the years, other great chains or systems of water, electric and gas utilities came into the PG&E system. Most notable among them were Great Western Power Co. of California (in 1930), and San Joaquin Light & Power Corp. (also in 1930).

Through a progressive program of consolidation, more than 500 predecessor companies have been blended into the PG&E corporate structure. This process was not carried out for the sake of bigness. Rather, it was the path of logical business leadership and was taken primarily for the betterment of service. For example, fast-growing northern and central California demanded an over-$1 *billion* investment by the San Francisco-headquartered utility during the short span of 1946 through 1953. This was the greatest construction phase ever to come across the scene of gas and electric utility operation. An integrated program of this scope would have been beyond the realm of possibility for the complex of many smaller utility companies—often working at cross purposes—from which Pacific Gas & Electric emerged.

NATURAL GAS COMES TO PG&E

In the late 1920's natural gas had made its debut in several parts of the country. In doing, it had opened the door to modern convenience via a cleaner, cheaper, more versatile fuel, with a higher heating value per unit volume, to the gas utility industry.

California had experienced very limited natural gas service for many years. As previously mentioned, natural gas was available in Stockton in 1864 in sufficient volume to heat and light the courthouse. Subsequently other wells were completed in the area.

Various other more-substantial gas strikes began to turn up as California's oil play boomed. Natural gas was utilized at Santa Maria, Maricopa, Taft, Fellows, and Bakersfield. These were primarily oil field towns and were located relatively close to sources of production.

In 1913, however, the California natural gas operations started to take form. In that year, Midway Gas Co., related to San Joaquin Light & Power (later to be consolidated into PG&E), started delivering natural gas to the gem of California's southland—Los Angeles. Production was from Buena Vista Hills in Kern County. Remarkably, it was brought to the Los Angeles basin via a 107-mile pipeline that traversed the formidable Tehachapi mountains—among other geographical problems. However, this natural gas was mixed with artificial gas for sendout by the local distribution companies.

Los Angeles and Southern California pulled ahead of the PG&E service area in natural gas utilization during the early 1920's. The reason being that there simply were no economic gas reserves available to the northern California company during that period. On the other hand, oil and gas fields had been proven up in and around Los Angeles, and the natural gas brought to market.

The year 1926 was one of change and destiny for Pacific Gas & Electric. Dry, high-pressure natural gas was hit near Elk Hills, some 250 miles southeast of San Francisco. With its availability and with some surplus natural gas to be had from Ventura, PG&E's management and technical people started seriously considering that fuel for their systems.

Pacific Gas & Electric started negotiations with Milham Exploration Co. (which brought in the Elk Hills gas) and Southern California Gas Co. (which had the Ventura gas) for the purchase of this energy

source. A pipeline was planned from Ventura, to Buttonwillow (where Elk Hills production was available), and on into the Bay city. Surveying started and a contract was put together.

These plans and the unsigned contracts were quickly shelved by the discovery (again by the Milham company—owned by Ogden Mills and John Hammond) of Kettleman Hills. This field was established for gas production when the Elliott No. 1 well was completed at 7236 ft TD on Oct. 6, 1928. It tested at 90 MMcfd and was the outstanding high-pressure gas producer of its day. The location was 49 miles closer to San Francisco than the Buttonwillow production.

PG&E's president, Mr. Hockenbeamer, quickly took off to tour the two fields. He decided to take natural gas from both Elk Hills (Buttonwillow) and Kettleman Hills. Over $13 million would have to be invested in a pipeline to bring the natural gas to San Francisco. But, as Hockenbeamer said:

"This undertaking will prove the greatest contribution of this generation to the growth and development of the Bay area. Natural gas is a cheap and efficient fuel which will not only attract new industries but keep the old ones here . . . Domestic consumers will also profit. Natural gas has greater heating value than artificial gas. With increased heating value and with rate adjustments we propose to make, consumers in the Bay area will save $3 million a year in their gas bills."

Mr. Hockenbeamer was accurately prophetic in all but one of his predictions. He missed the savings natural gas would bring to domestic consumers rather widely. Natural gas proved to mean annual savings on domestic gas bills of the period that were closer to $10 million.

A 250-mile pipeline was started in January 1929. It consists of 16-in. pipe from Buttonwillow to Kettleman Hills; 22-in. pipe on up into Fresno county; and 20-in. to Milpitas on San Francisco Bay. From there, a 20-in. line branches along the eastern shore to serve Oakland and Richmond. The mainline continues 44 miles up the peninsula to reach San Francisco.

As is the practice of any good pipeliner, no sooner had this line been started, than PG&E started thinking in terms of new pipelines to bring additional natural gas to its consuming public. Adequate reserves were to be had from the oil fields on the west side of the San Joaquin valley, so PG&E planned to pipe this into Milpitas via a line that would bring natural gas to all Bay area cities and would completely loop San Francisco Bay.

Work had started on this line when it was learned that Standard Oil Co. of California also planned a line from this same region to its refinery at Richmond. To avoid duplication of facilities, the two companies agreed to build a joint venture of greater capacity. A new company was formed—Standard-Pacific Gas Lines Inc.—and the line was built. It is known as the "Stanpac Main" and its essentially 26-in. diameter delivers approximately 200 MMcfd into Pacific Gas & Electric's system.

Natural gas arrived in San Francisco and Oakland almost unheralded in Aug. 16, 1929. A massive operation to convert the system and appliances of some 183,000 gas consumers in the San Francisco area was carried out with military precision. The job was completed in July of 1930. By the end of that year, nearly all of PG&E's Bay area consumers were enjoying the benefits and advantages of natural gas. It was a $2 million conversion, involving over 1,750,000 appliances. Negligible interruption of service was experienced.

Once headed in the natural-gas direction, Pacific Gas & Electric never looked back. New fields were sought and exploited by laying pipelines and distribution systems progressively throughout its service area. The gas system was busily growing and progressing all through the thirties.

World War II brought an abrupt end to just quick growth. That wretched event caused PG&E's gas business to skyrocket. Requirements of defense activities boosted its gas sales to four times what they were in 1930; and, at the close of 1945, the 89 billion cu ft delivery of 1941 had been increased by more than 150 per cent. Significantly, during the war period there had been no new major natural gas discoveries within California.

However, the two backbones of the system—the Kettleman Hills and Stanpac lines—with their 350 MMcfd, and as augmented by natural gas supplies from the Central Valley region of northern California, provided sufficient intrastate production to meet gas requirements through 1950. Long before that time, however, Pacific Gas & Electric had directed its attention to out-of-state gas producing areas.

Somewhere around 1944 studies and statistics indicated to planners in PG&E that the trends were going to call for different action in the future. While California gas production was increasing, the rate of increase lagged the rate of increase in demand. It was not an immediate problem. But shrewd forecasting showed that a few years in the future it would be. In-California production simply would not keep pace with the tremendous expansion of the population, commerce and industry, and economy of central and northern California—and the rate of increase in demand for natural gas energy therefrom.

The situation was to come to a head even sooner in Southern California—an area served by Pacific Lighting Corp. subsidiaries, Southern California Gas Co. and Southern Counties Gas Co. So, a cooperative program was arrived at to investigate bringing out-of-state natural gas to California.

Southern Counties Gas' Arthur Bridge spearheaded this work. PG&E people helped bring the matter to reality. The El Paso Natural Gas Co., then as now headed by Paul Kayser, held the answer to post-war years' gas supply for all of California.

In 1947, connecting pipeline projects were completed by Pacific Lighting companies and El Paso Natural to link vast volumes of natural gas from the Permian Basin fields of Texas and New Mexico with Southern California. There soon followed a contract between Pacific Gas and Electric and El Paso Natural for 250 MMcfd of Permian gas to be delivered to PG&E by EPNG at the California-Arizona border near Topock, Ariz. The San Francisco-area gas company would build the pipeline from Topock to San Francisco Bay.

Pacific Gas & Electric launched construction of its 34-in. pipeline in 1949. Pipe of this diameter had never been used in long-line gas transmission work previously. The route was less than ideal, calling for construction through the Mojave Desert, the Tehachapi Mountains, the San Joaquin Valley, and the Coast Range mountains. A joint venture of Bechtel Corp. (San Francisco), H. C. Price Co. (Bartlesville), and Conyes Construction Co. (San Pablo, Calif.) received the contracts for, and built, this line. The 502-mile, 34-in. welded steel pipeline became popularly known as the "Super-Inch." Construction was completed on Aug. 17, 1950.

From that point, the story of gas supply for Pacific Gas and Electric has been: (1) calling on El Paso Natural Gas for steady increases in deliveries of out-of-state gas, and (2), further development of in-California gas resources. Before long, the El Paso supply from the Southwest far overshadowed and left behind in-state production.

El Paso Natural built additional system to bring natural gas from the San Juan Basin (in the Four Corners area) to PG&E and California. Too, EPNG reached into the Panhandle fields of Texas. So from the Permian basin, Panhandle fields, and San Juan basin, the vast system of El Paso Natural Gas Co., teamed with that of PG&E, brought the energy of natural gas resources of the Southwest to homes, commerce, and industry of Central and Northern California during the fifties.

The Super-Inch grew and developed to bring additional "Texas" gas to the Bay area. Compression was added; taps were made to serve more towns, communities and industry within economic reach of its route; and its operations were sophisticated by additions of more advanced systems and equipment. By 1958, its entire length had been paralleled with a second 34-in. pipeline and some of its compressors had been supercharged. In that year its deliveries were upped to in excess of 1.1 billion cu ft per day.

Through the fifties there was growing awareness by PG&E planners that its 94,000 square mile service area was not going to suddenly stop growing in its needs for energy from natural gas and electricity. On the contrary, there was every indication that an amazing growth trend would continue through the sixties, seventies, and even beyond. As any good utility man knows, you can't wait for the demands to hit before planning facilities to serve them. You have to keep ahead of energy load growths, or an area becomes blighted and cannot realize its natural development.

PG&E could see growth in its service-area population which would result in an addition of 2 million people between 1950 and 1960. It had seen personal income of California residents trending upward fairly sharply. The same upward trend was seen for taxable retail sales and manufacturing employment. It knew this meant additional dwelling units, new commercial establishments, and all of the many things a growing, working, prospering population produces need for. Further, it estimated continued upward patterns for many years to come.

Analysis of other trends showed its service area to be located for growth. San Francisco is a gateway and doorway to industry and commerce of the Pacific, the East, and the world, for that matter. Northern and central California are logical distribution points for the West Coast and western states—with a population approaching 25 million.

LEFT: At summit of Livingston range, looking at the western slope. This is general view of Crowsnest Pass area. Pipeline ROW can be seen in lower foreground and again in right-center background. Turtle mountain and Frank slide are in left foreground. Alberta-British Columbia border is about 10-15 miles from this point, in the general direction of view (Sch. I, AGTL). ABOVE: Example of rugged country (Sch. I, ANG) in British Columbia, near Moyie lake. In spite of sack breakers, recent hard rain washed hard-to-get padding out of rock trench.

Resources availability also led to conclusions of a continued high rate for the area's development. Forests invite lumbering, pulp, and paper mills. Minerals are there and the extractive industries have great potential in the Sierra Nevada and Coastal ranges, and on the Mojave desert. Agriculture has always been big in California and new uses for such products, and wastes and by-products from them, are always being discovered and promoted.

As for natural gas specifically, a growing population with increasing income tells its own story for domestic sales potential. In addition, the thermal generation of electricity had to be considered. And PG&E knows that clean, low-cost, convenient natural gas will be needed for the furnaces, forges, boilers, kilns and ovens of the future. Too, the miracles of petro-chemistry will bring need for natural gas as a raw material.

With every study and investigation, the results were the same. Pacific Gas & Electric must have vast additional volumes of natural gas to meet the energy demands of the population and economy of its service area for the years ahead. Thus, in the late forties and early fifties, it turned part of its attention to planning for the fulfillment of additional gas loads to come.

All through this period a close watch was maintained on any and all natural gas field developments in the West and Southwest of the United States, in Mexico, and in Canada. Canadian gas drew particular interest when Westcoast Transmission Co. Limited proposed to serve a considerable portion of the U. S. Pacific Northwest with Canadian-produced natural gas. This project gave indication of gas reserves in Canada. Not just simple gas reserves, but sizable gas reserves with long life and great potential for growth.

PG&E entertained discussions with Westcoast Transmission backers concerning future deliveries to the Bay area. Then, with the advent of the Pacific Northwest Pipeline Corp.'s project—now an element of El Paso Natural Gas Co. serving the Pacific Northwest—conversations were held with Ray Fish and associates who felt a branch line dropping off the Pacific Northwest pipeline in Oregon and building into the area of San Francisco would be propitious.

However, Pacific Gas and Electric had been offered additional volumes of natural gas from the existing EPNG system at this time. In addition, natural gas strikes and field development were moving ahead rapidly in western Alberta. So, it was decided not to participate with the by-then amalgamated Westcoast Transmission-Pacific Northwest pipeline projects.

What PG&E was really looking for was a completely new gas supply area. This was no reflection on the El Paso Natural Co. On the contrary, Pacific Gas & Electric felt that El Paso had done an outstanding job of supplying constantly-growing volumes as needed. PG&E knew that EPNG personnel would continue to do so. The San Francisco company had great confidence that El Paso's vast system—stretching throughout the Southwest and to the Canadian border—would continue to offer security of gas supply coming to PG&E area from the Southwest. The attraction of supplementing this sure gas supply from the Southwest with an independently controlled supply

Further downstream, river weights are moved to ready storage in British Columbia, approaching the International Boundary (Sch. 1, ANG).

from the north seemed to PG&E to offer ultimate in long-range security of adequate gas supplies for all needs of every class of customer.

Consequently, PG&E in the mid-fifties turned its attention to very close investigation of gas production and potential in western Alberta.

NATURAL GAS IN ALBERTA

The gas fields of Alberta we are most interested in here are spotted about in the eastern foothills of the Canadian Rockies. This "foothills gas" is taken west of the 5th median. To the east, good fields are located also. However, most of the Eastern Alberta gas that is available for exportation from the province, is dedicated to Trans-Canada Pipe Lines Limited.

Development of Alberta's foothills gas was pioneered by Shell Oil Co. of Canada. Interestingly, most experts on the ground estimate that the natural gas potential in Western Alberta has hardly been touched.

Much of the foothills natural gas is found occurring in reefs and reef systems. These are typically coral reefs, formed eons ago, and overlaid with green shales. They take many and varied shapes—some being biohermal, or relatively confined and thick; others are biostromal, tending to be relatively thin and very extensive. Such reefs are located through surface geology and seismic-isopacks.

This reef gas is usually sour, and is apt to be wet. Nonassociated gas is to be expected from the reefal reservoirs which display very good porosity and permeability. A substantial portion of the gas that will flow from Alberta to the Bay area is produced from wells taking production from Leduc reefs of Woodbine age. Such fields are the Dick Lake or Westerose South, Pine Creek, and Windfall—though Windfall may have a thin oil leg.

A second general type of field in western Alberta of importance to the project produces Mississippian gas from pinchouts overlain with Jurassic shales to form stratigraphic traps. These fields lie on the flanks of the Mississippian basin and are tough to find. The answer is straight geology and drilling exploratory wells. The Crossfield field is typical.

Deeper in the foothills, gas fields are found in the very faulted, folded geology. Here, extensive thrust sheets are typical. Waterton (Mississippian, Devonian) and Castle River are of this type. Others are Wildcat Hills (Mississippian), Turner Valley (Rundle associated, Rundle solution), and Pincher Creek (Mississippian). They may lie on a common huge thrust fault. Every well is a wildcat in this area.

Another interesting field from which second-stage gas supply is available is Kaybob. It has four production zones—Notikewin, Cadomin, Winterburn, Beaverhill Lake solution.

Without going to a lot of detail, suffice it to say that the new PG&E gas supply is tapping one of the most prolific and high potential natural gas producing areas on the North American continent. The pipeline segment in Alberta—to be owned and operated by the Alberta Gas Trunk Line Co. Ltd., about which there will be more later — was purposely routed through foothills areas of greatest future potential.

For a look at those reserves, the published report of Canada's National Energy Board to the Governor in Council, dated March 1960, are reliable. NEB estimates established reserves of natural gas were 30.3 trillion cu ft at end of 1959. Total initial disposable reserves in Canada (exclusive of the Yukon or Northwest territories) will increase from that figure to some 92 trillion by end of 1989.

The Board's estimate of Alberta reserves "after allowing for production prior to 1960," is 74 trillion cu ft. And the National Energy Board draws attention to estimates by the Canadian Petroleum Association which indicate that "with proper incentives" for further exploration, "ultimate reserves discovered in the Western Canadian basin would be in the order of 300 trillion cu ft."

If this potential is reached, it will mean a lot of drilling will have to be done. It should be remembered that western Alberta or foothills natural gas reservoirs are generally deep. This in turn means deep wells, and each Alberta wildcat venture to typical depths requires an investment averaging $750,000.

Construction story begins on page 105

The Federal Power Commission TODAY

The Federal Power Commission, bogged down in a tremendous work-load and snail-slow procedure, is today under the glare of public scrutiny. In this, the second part of a three-part look at the agency, the editors of GAS Magazine tell where the commission stands, what it does, and what its problems are now.

By NEIL REGEIMBAL
GAS Washington Bureau

TODAY the Federal Power Commission is in a position similar to a James Thurber character who suddenly finds himself in the center of a Times Square mob without any clothes on.

After two-score years of quietly wading through an increasingly deep and murky bog of regulation in relative obscurity, the commission is suddenly in the limelight. True, the attention is shared by the other regulatory agencies. But the light is bright nevertheless.

These agencies are today in the center of a bitter controversy. The FPC and the Civil Aeronautics Board have felt the most stinging blows. But others, including the Interstate Commerce Commission and the Federal Communications Commission, have also been subject to severe congressional and public criticism.

Their troubles stem mainly from laws which have not kept pace with the intricacies of modern business technology and economics, and from the need of formal liaison between regulator and regulated—which sometimes drifts into informal personal relationships.

The FPC, neither more nor less than the other federal regulatory agencies, is charged with a dual task which often appears contradictory. It must regulate gas and electric industries to protect the consumer. It must also promote development of these industries. In fact, promoting sound development is to the benefit of the consumer. But the line between the best interests of the consumer on one hand and the industry on the other is often thinly drawn.

As in the case of all the regulatory agencies, the commission is often at the same time prosecutor, judge and jury, and appeals court.

The FPC is composed of five commissioners. They are named by the President to five-year terms, subject to confirmation by the Senate. One is designated chairman for his term by the President. (Jerome Kuykendall was named chairman when appointed by former President Eisenhower to a term ending in 1962. The Kennedy Administration this spring fought and won a battle to name a new chairman before the Kuykendall term expired.)

The commissioners are primarily the judge. They are also policy setters in interpreting regulatory laws. In addition they have the administrative job of running the agency.

The jury that weighs the economic fate of firms seeking certification or approval of rates is in this case a single man—the hearing examiner. These examiners, employees of the commission, conduct the long, cumbersome hearings and recommend decisions to the full commission. The commission is not bound to follow them, but very often does. The commission employs an average of 15 hearing examiners.

Lawyers, staff accountants, engineers and other experts, become almost the prosecution in contested cases as they argue a particular proposal of one firm.

Major functions of the commission are many and varied. Here is a sample:

Gas regulation—Issues certificates for construction, extension, operation of natural gas pipeline crossing

state lines and for producers selling in interstate commerce for resale; authorizes sales by interstate pipelines to distributors, and approves abandonment of service; sets rates for producers and pipelines selling natural gas in interstate commerce for resale; collects and publishes statistics on firms subject to its jurisdiction; issues permits for foreign export or import of natural gas.

Power regulations—Issues and controls permits for planning, construction, and operation of private hydroelectric projects on federal land and water areas; regulates interstate commerce in electric power and utilities transmitting it; collects and publishes statistics on electric power utilities; advises on electric potential of federal dam projects; allocates costs of federal hydroelectric projects and confirms rates for power sales from them; controls export and import of power.

One of the biggest problems facing the FPC now, and the other regulatory agencies too, is a tremendous backlog of cases. In any major case filed today, it will probably be nearly a year at the earliest before a final decision is made by the commission. Appeals from the decision to a court by either side naturally extend the case even more. Some major cases have run three and four years. The landmark Phillips case, mentioned in the first article in this series, took 12 years to complete.

In 1960, the FPC began a series of administrative changes in its procedures, including "interim order procedures," pre-hearing conferences, and limiting the right of "interested parties" to intervene, in an effort to speed up its proceedings.

Real cause of the long delays is, of course, the Phillips decision putting almost all independent producers under federal control—the big ones and the little ones, too.

But a certain amount of delay is built into the FPC system, due to the need for detailed studies and "due process" or fair trial for all parties concerned.

The commission is made up of several parts. Each of the five commissioners has his own office personnel. There is in addition a large commission staff, headed by an executive director, to conduct the studies necessary and advise and help the commissioners wend their way through the regulatory maze. This staff is segregated into the following divisions:

Bureau of power, bureau of rates and gas certificates, office of the general counsel, office of the chief accountant, office of the secretary, office of hearing examiners, office of special assistants to the commission, office of public reference, and office of administration.

Most of the several thousand cases coming before the commission are brought by the gas and electric industries—primarily the gas industry. These arrive when a firm proposes to build a pipeline, extend a line, add or subtract customers, or change its rates. The commission may also initiate its own studies of rates, services, or general problems affecting the industry.

When a gas firm comes to the commission seeking approval of a project or rate change, the application first is sent to the staff to make certain all requirements for filing are met. If so, the notice of the application is published, and interested parties are notified. If there are no objections or intervenors, the case is quickly run through an abridged hearing process and the commission approval is almost automatic.

When there are objections or parties seeking to intervene to block, change, or to provide the same service, the regulatory wheels go into motion—slow motion. Formal hearings are set, briefs filed and oral arguments held, and eventually the hearing examiner makes his finding. Then still more briefs are filed in an appeal to the commissioners and arguments held. Finally, the commission approves, disapproves, or changes the hearing examiner's findings.

In some cases, particularly where time is an important factor because of financing or to get construction started before bad weather, the hearing examiner's decision can be omitted and the case sent directly to the commissioners.

Growth of the natural gas industry, from 6.7 million customers and $400 million in revenues in 1938 to 29 million customers and $4 billion in revenues in 1959, has, of course, also contributed to the commission's problems.

But the Phillips decision rises above all other factors as the main source of the commission's mired condition. From the time the decision was handed down in 1954 through June 30, 1960, the FPC received 13,247 applications from producers just for certification to sell gas in interstate commerce. They are still coming in at the rate of better than 1600 a year. The commission disposes of only about 1200 a year. All pipeline certificate applications (about 300 a year), pipeline rate applications (about 1300 a year), and producer rate cases (almost 10,000 a year) are in addition to producer certificate filings.

Many filings, of course, are only technical in nature, required only because of the intricacies of the law and are processed automatically.

There is another reason why these agencies, including the FPC, are now under fire.

Because of the highly technical nature of their day-to-day work, the public in general does not come into contact with them, and hears about their actions only infrequently. As a result, these agencies long ago drew into a shell formed of red tape and lack of public understanding.

This shell was cracked once in a while over the years, but held up pretty well until a couple of years ago when a congress of one party began scandal hunting for political purposes and focused on these agencies with startling results.

Suddenly, the shell was broken. While the scandals quickly faded after the elections, these agencies—some more than others—are now left relatively unprotected from the public spotlight.

This is good. While it may be a little painful under the glare until hides are toughened up, there is, as every sunbather knows, a healthy benefit from a moderate suntan.

This new interest in these agencies, partly political, partly economic, partly legal, will bring, in time, a new and better type of federal regulatory process. The possibilities for change, in procedure, in amount and in type of regulation are varied. ■

(Next month: What's in Store for the FPC).

FUEL CELL Literature

Three book reviews and a paper abstract present a wide-angle look at this topic of top current interest, giving varying views of the role of gas.

By ROBERT CLAY
Managing Editor

"FUEL CELLS—Power for the Future" by graduate students at the Harvard Business School. Soft-bound, 160 pages, 8½ x 11; $18.75; Fuel Cell Research Associates, Box 157, Cambridge, Mass.

The fuel cell should soon play a major role in industry and almost every sector of society should benefit. However, propane—rather than natural gas or any other fuel—appears to offer the best possibility of emerging as *the* fuel for fuel cells.

Those are perhaps the two most important conclusions to be drawn from this volume, which is subtitled "A Technical and Economic Analysis of Developments and Opportunities in Electrochemical Fuel Cells." Co-authored by five engineering and four business and liberal arts graduates, it was a group thesis for master's degrees from the Harvard Business School. As a study in the fuel cell field, it is a landmark, as indicated in the preface:

> "While some brief articles had been published in various business and engineering journals describing fuel cells in general terms, the majority of writing was of a technical nature and was directed to electrochemists. Our study, economic and engineering in nature, was to be directed not only to a technical audience, but also to the general business audience."

The Army Research Office, in its "Second Status Report on Fuel Cells" (see accompanying review), favorably defines the Harvard students' work as "not only a technical review, but an intensive and extensive economic appraisal of present and expected fuel cell systems as applied to trucks, automobiles, construction equipment, aircraft, locomotives, boats, and ships."

This, then, appears to be the first actual dollars-and-cents evaluation of the fuel cell and some of its many apparent applications. As such, it is—at least in this one sense—the most important piece of fuel cell literature yet published.

Since it draws quite a number of specific, concrete conclusions in a field still in its infancy—and since some of these conclusions either include or exclude vast numbers of the myriad possibilities—this is bound to be a controversial study. It therefore seems necessary to substantiate the work by revealing that the students: 1. Studied textbooks, lectures, articles, papers and patents; 2. Traveled over 10,000 miles at their own expense to get first-hand knowledge from companies and individuals doing research in this and related fields; and 3. Submitted this study to some 15 experts for pre-publication criticism and suggestions.

All this effort was channeled toward two objectives, which the students spell out in the preface:

> "One objective of this study was to determine the commercial and engineering practicality of present and potential fuel cells. This has been done by establishing a method of evaluating fuel cell performance (Chapter IV), analyzing existing fuel cell developments (Chapter V), and comparing present and future fuel cells with conventional sources of power in various power applications (Chapters VII and VIII). We hope that our unique approach for economic evalution . . . will be a major contribution to the art and science of fuel cells. A second and equally important objective was to investigate the status of fuel cell technology and to present the technical operations and limitations of fuel cells (Chapter II) and to investigate the various chemical fuels used in fuel cells (Chapter III). In addition, it was desirable and necessary to include a technical and economic discussion of d-c motors to complete the fuel cell study (Chapter VI)."

Summaries at the end of each chapter make it very easy for one to gather the basic substance of the chapter in a paragraph or two. In addition, the last chapter—only a little over three pages long—is a summary of the book, enabling one to superficially comprehend the entire volume in a few minutes. However, if you have any interest in fuel cells, be prepared to spend hours with the book. You'll find the conclusions so fascinating that you'll pour over the book in detail to determine how the authors arrived at those conclusions.

What are some of these conclusions? We can only mention those that seem most important to *GAS* readers. Of course, for the details on how these conclusions were reached, you'll have to read the book. Right here, we'll consider the conclusions in two groups: first the cells; then, their application.

A preliminary conclusion the reader must assimilate is that "the fuel cell is definitely not in the class of exotic power sources and should soon play a major role in industry." That statement is much easier to comprehend when one is made aware that there will be three stages of fuel cell development, corresponding roughly to: right now, five years from now, and 10 years from now. The corresponding terms are: present, near-term, and long-range.

Among present cells, the one "closest to being practical for commercial applications", is the hydrogen-

oxygen cell developed by Union Carbide Co. This unit consumes hydrogen and oxygen, is handicapped by the hard-to-handle qualities of these two fuels—in addition to weight, size, and price handicaps. During the present year, however, Union Carbide is testing fuel cells in in-plant vehicles.

The near-term fuel cell, the study concludes, will most likely be the dissolved methanol cell. Its size, weight, and price handicaps are not as bad as the hydrox cell and methanol not only presents no major handling problems, but is cheaper and can be produced from natural gas. The students found Monsanto Chemical Co. and Esso Research and Engineering Co. to be ahead in this field.

The long-range cell—and remember, that's only about 10 years off—is the low temperature and pressure hydrocarbon cell. This is the device that's expected to literally move mountains in 10 to 15 years. And, should the study's conclusions come true, this is the cell that could cause a major upheaval in the oil industry but could leave the gas industry virtually untouched.

A fuel cell, it must be remembered, is nothing more than a highly sophisticated way of combining hydrogen and oxygen. Present cells use pure oxygen but future cells are expected to simplify—by means of yet-undiscovered catalysts—things to the extent that ordinary air will supply the oxygen. The big problem, then, is getting the hydrogen; and small molecule hydrocarbons appear to be the answer—to the Harvard grad students.

But here's the real shocker for GAS readers: methane is virtually excluded from the discussion. Propane is mentioned most often—actually, almost continuously. Butane and ethane follow. However, one of the few times methane is mentioned in long-range fuel cell development, it is kept in the running:

"Although methane at this time appears inert (to foreseeable catalysts), it must not be ruled out as a possibility."

Should the natural gas fuel cell prove feasible, the study finds that it would beat the propane cell by substantial margins on weight, initial investment, and fuel costs. Both types show such tremendous reductions along all three lines—when compared to present projections—that some such comparisons are just plain hilarious.

Here's the way the study thinks it will all work out. Hold on to your chairs! Propane will replace gasoline as the principal product of refineries. When this happens, demand is expected to boost the price of propane about 50 per cent for large users, about 400 per cent for small users.

These two increases are assumed in all calculations to determine the economical practicality of the long-range hydrocarbon fuel cell in a wide assortment of applications, to provide both mechanical and electrical power.

To determine the mechanical aptitude of the fuel cell, the group selected eight specific applications "chosen as representative of the wide range of possible mechanical power systems." They are: city delivery trucks, industrial trucks, automobiles, construction equipment, light aircraft, locomotives, outboard motors, and marine applications.

Now it's time to hang on to your hat! The long-range hydrocarbon fuel cell proved physically and economically suitable in seven of the eight applications. The only absolute exception was the light plane, where the application proved comical rather than practical. (The cell and its attendant d-c motor would weigh more than twice the weight of an entire comparable plane powered by a conventional engine.) In two other applications, autos and outboards, the possibilities seem limited to smaller or slower units.

Autos—because of their widespread usage, their effect on the nation's economy, and the interest they always seem to generate—seem worthy of a separate paragraph in this review. The study came up with 12 different sets of figures, representing three different kinds of cars, each having: a present gasoline engine, a present fuel cell, a near-term fuel cell, and a long-range fuel cell. The three kinds of cars were: a 4000-lb family car with an 80-mph top speed, a 2400-lb town automobile with a 50-mph top speed, and a 4000-lb taxi with a 50-mph top speed. Present and near term fuel cells proved impractical for all three types. The long-range, hydrocarbon-air cell looks as if it will work very well in the town car and taxi, but not in the high speed family car. In the two slower vehicles, the long-range fuel cell power plant (including d-c motor), would provide a slight weight penalty, but would offset this by cutting power-plant volume to half that of a normal engine. Initial costs could be in the range of present engines, but operating costs would be only a small fraction of what they are now, 0.4 cents/mile for the town car, 0.8 cents for the taxi. In the family car, the fuel cell compares very favorably in power unit volume and operating costs, but its weight and cost (2150 lb and $1650—both figures for the power unit alone) rule it out. (If you want a real laugh, you could probably build a fuel cell family car today, but its power unit would: weigh 10,250 lb, occupy 200 cu ft, and cost $6880.)

The report sums up the mechanical power application picture like this: "We expect that it will be about 10 years before we see widespread use of fuel cells (assuming the required breakthroughs in cell performance are accomplished) in automobiles, construction equipment, and electrical-drive marine installations. Use of fuel cells in locomotives and ships (other than electric drive installations) will probably not occur for 15 years. Applications which experience high operating costs, such as delivery trucks, industrial trucks, and

possibly taxicabs, may use fuel cell power sooner than 10 years, perhaps in 5 years. . . . Economical fuel cell operation holds great promise for many other applications. For example, city transit buses, street cars, and subways would not require the construction and maintenance of unsightly overhead power cables if they were operated by the fuel cell. The gasoline farm tractor is another vehicle which could be replaced by a fuel cell farm tractor. Fuel cell-powered irrigation and oil pipeline pumps are attractive because of the lower maintenance required for the fuel cell-d-c motor system."

While this study finds such great and diversified promise for the fuel cell's mechanical applications, its outlook for electric power application is not as rosy as might be expected. This is particularly true with the application we hear most frequently discussed in the gas industry—the truly all-gas house with a natural gas fuel cell providing all electricity. The study looks at the situation from the electric angle. It says that electric heat—even when supplied by a fuel cell—"does not appear to be economically feasible." Therefore, it concludes, the one-power-source house is not probable unless the fuel cell achieves "economic and social acceptance" as the power source for the home. Apparently these researchers—doubtful about the natural gas fuel cell—never considered what the Southern California gas utilities envision as the "Balanced Power" house of the future, with gas and electricity each doing the jobs they can best do, but with gas supplying electricity via a fuel cell. They conclude that the chief domestic use for the fuel cell will be beyond present electric systems—both in remote areas in this country and in the large undeveloped continents, Africa, South America and Asia.

To sum up the rest of the power picture, the study found that "it is very possible that the high temperature fuel cell will prove to be a competitive source of power in small capacity power plants." And if the cost of propane would remain at its present level, the low temperature fuel cell "could almost equal" the predicted cost of electricity from large atomic plants.

The conclusions on auxiliary and portable generating plants are even more optimistic:

"Fuel cells may make a slight entry into very small size standby and small power applications within five years, and will become a major factor in the standby and small power plant field within 10 years. If the fuel cell develops as anticipated, it is probable that most new installations . . . after 1970 will be fuel cells."

The last conclusion drawn in the book is that "what is most needed at present is basic research in the field of electrochemical catalysis of hydrocarbons and in the design and construction of more effective air electrodes." Gas industry people—disappointed over the study's poor prospects for methane—will chorus a loud "Amen!" to that conclusion.

This may well be the longest book review in the 36½-year history of GAS. It certainly must be one of the most important books reviewed in these pages, for it forecasts—through logical economic processes—great changes that should surely affect this industry in one way or another. And it certainly must be one of the most interesting books ever reviewed in GAS, for nothing is as fascinating as the future, and few forecasted projects are more far-reaching than the fuel cell.

"Status Report on Fuel Cells" by B. R. Stein. Softbound, 116 pages, 8½x11; $1.25; Office of Technical Services, Department of Commerce, Washington 25, D. C.

Late in 1958, the Department of Defense held a Seminar on Advanced Energy Sources and Conversion Techniques. As a result of this and subsequent meetings, the Army Fuel Cell Steering Committee agreed to publish a series of reports on the status of fuel cell activities. The committee is composed of representatives of the Signal Corps, the Ordnance Corps, the Corps of Engineers, and the Army Research Office, all of whom made major contributions to the volume under consideration.

As the first of the series, the report under review not only attempts to outline the progress of all then-known fuel cell projects, but also contains important basic introductory and historical material, as well as a comprehensive bibliography. Much of the space is devoted to rundowns of the various types of fuel cell systems and of the fuels, themselves. Such basic information makes this report a good place to begin to get acquainted with fuel cells.

"Second Status Report on Fuel Cells" by B. R. Stein and E. M. Cohn. Softbound, 80 pages, 8½x11; 75 cents; Office of Technical Services, Department of Commerce, Washington 25, D. C.

Eighteen months of progress in the fast-moving fuel cell field are delineated in this second report from the Army Research Office. Like its predecessor, this work contains all non-classified, non-proprietary information gathered by the office. The only source of information not tapped is patent literature, and this source is expected to contribute to the third report, whenever that is published. The date will be determined "by interest and progress in this field."

The snowballing interest in the field is clearly shown by comparing material in the first and second reports. In the first, there was information on 11 government-sponsored research contracts. In the

FUEL CELL Literature

second, there are 37 such contracts. The principals, scope, progress, and other details of each contract are included. A large number of supporting research projects are also listed. In addition, there are the various projects being carried out by the government, either through the Armed forces or through the National Aeronautics and Space Administration. Much less information is available on this work. All in all, the government is now spending nearly twice as much as when the first report was issued.

This is the latest, most complete round-up available on fuel cells. In a field of such intensive interest and activity, it sometimes seems almost humanly impossible for the casual observer to keep up to date. This piece will do the job better than anything else around and so should be a must for anyone interested in fuel cells.

"Natural Gas Fuel Cells for Power Generation in Dwellings" by E. B. Shultz, Jr., K. S. Vorres, L. G. Marianowski, and H. R. Linden. An AGA paper presented at the Research and Utilization Conference in Cleveland, April 4-6.

Noting that over 60 industrial and government fuel cell projects are known to be in existence, this joint presentation by four Institute of Gas Technology researchers tells of the work going on in the IGT labs. Their approach, of course, is from the gas viewpoint:

> "In many areas of the country, a unit of energy in the form of gas costs the residential customer only one-sixth to one-eighth as much as a unit of energy in the form of electricity. It seems likely that this basic cost advantage will be large enough to offset the unavoidable additional costs in converting energy to electricity in a multiplicity of small installations. This should be possible primarily because of the relatively high efficiency of low unit cost of small fuel cell systems. The low cost of transporting and distributing energy to the consumer's home in the form of gas would then make possible the convenience and versatility of a single source of heat and electrical energy in an all-gas home."

The paper concedes that "At this time, the direct electrochemical oxidation of gaseous methane does not appear practical because of its low reactivity in fuel cells of all kinds."

However, it is quick to add that two different approaches present a total of five possible gas-using fuel cells. In one approach, methane is used directly; in the other, indirectly. In the latter, methane is first converted to a hydrogen-rich stream in external apparatus by either steam reforming or partial oxidation. The resulting impure hydrogen could then be used in any of three different types of cell: the aqueous hydroxide fuel cell, the cation exchange resin membrane fuel cell, and the acid fuel cell. The first two are believed too expensive for widespread use and virtually no research work has been done on the acid fuel cell.

The direct approach is therefore considered the best bet for the all-gas house. While methane by itself will not oxidize rapidly enough, it will do so in a high temperature fuel cell if steam is present. Two types of electrolytes have been used in these high temperature cells: molten carbonate mixtures and solid ionic oxides.

The molten carbonate cell is currently far ahead in development and is termed "a prime candidate for development in a natural gas appliance." The institute last year developed and tested a six-cell molten carbonate unit housed in a gas-fired furnace fired with waste gas from the cells. This year, it is building a 100-watt unit and conducting other experiments with molten carbonates. However, molten carbonates do present some inherent disadvantages.

For that reason, solid oxide cells "hold more promise if new theories lead to the choice of better electrolytes and if engineering efforts to make practical cells are successful." Current research on this type is expected to result in single cell tests during 1961.

While the institute will make "a technical and economic evaluation" of the indirect approach to using methane, it currently believes that the gas industry's future in the fuel cell lies with first, the molten carbonate cells, and, later the solid oxide cells. When they became available, the solid oxide cells would merely replace the molten carbonate cells in the domestic installation. This domestic installation would be designed to run continuously—producing, perhaps, 1 kw. Electricity not used immediately would go into storage batteries, which could supply a peak of, perhaps, 10 kw. This would be much cheaper than a 10-kw unit without batteries, the IGT people feel. Already existing semiconductor devices could convert this direct current to alternating current. Waste heat from the cells would be used in conventional appliance functions.

The prospect of such an all-gas house will have all the boys in the gas industry cheering every inch of ground gained by IGT. Meanwhile, presumably, our brothers over in the L.P. gas industry will be cheering every advance toward the Harvard boys' goal of propane fuel cells for everything. It all promises to be as exciting as an intersectional college football game, but the stakes are infinitely higher—the winner very well may be the prime energy supplier of the future. ■

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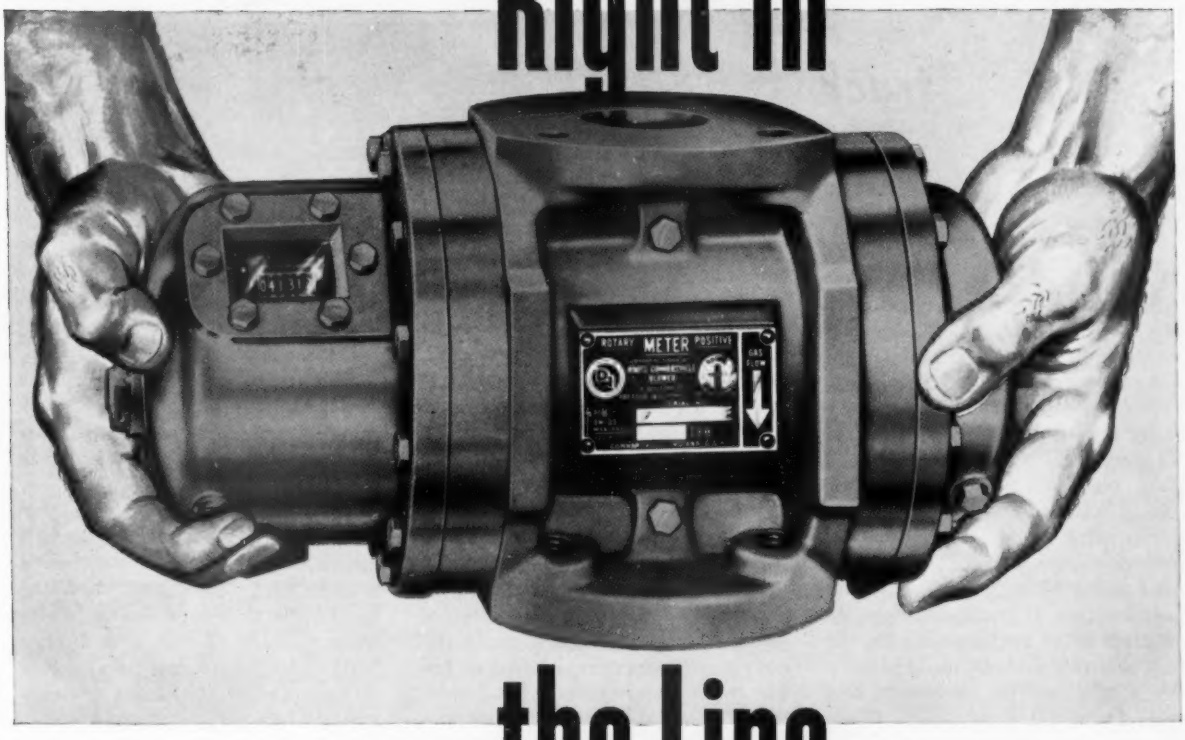

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Everything on one truck

PSCo. of Colorado street crews work from new truck.

NOT too long ago, the gas department of Public Service Co. of Colorado (Denver), decided that a more efficient service unit for the gas street crews could be designed.

The crews had been using a specially designed truck with the conventional tool box trailer. While it gave reasonably satisfactory service, it was believed that something better could be devised.

Various ideas from PSCo. people were gathered by Frank Raglin, superintendent of transportation. He selected what appeared to be the best and roughed out an idea for a truck to carry all equipment and tools for a gas street crew. Then he took the rough idea and all the equipment, tools, fittings, etc., that a crew normally would need to the Winter-Weiss Co., a truck body manufacturer in Denver.

The resulting design has more than proved itself in actual use and the street crews are enthusiastic about it. It is compact and efficient and saves crew time in many ways. There is no tool box trailer, no separate tank for water. There is a place for every single tool, fitting, piece of equipment or bit of supply that a crew would normally need.

Any crewman can immediately lay his hands on any item wanted. If by chance the crew is unexpectedly shifted to another job, the tools and supplies are right with them and they don't have to stop to pick up a tool box.

The unit shown here is mounted on a two-ton Chevrolet Viking Sixty. (It can be and has been mounted on other makes as well.)

Two 40-gal. high-pressure water tanks serve as stringers under the truck body and furnish water for the water boring method of running a new connection from the street to the customer's property. Compressed air into the tanks provides water pressure. The tanks are interconnected and may be drained quickly if necessary.

A 125-cfm heavy-duty air compressor mounted in the front of the truck body is protected by a heavy wire mesh screen. Right behind the compressor is a hydraulic winch for use in pulling the boring machine and for other odd jobs.

A live hose reel is mounted on the right rear of the truck. On the left rear is a small bin which carries black top for small street patching jobs.

Metal pipe is carried in a rack on the left side. A special rack mounted above the compressor carries 250 ft of ¾-in. plastics pipe in a horizontal position.

There are five tool or fitting compartments on each side, with each compartment designed for a specific purpose. A compartment under the truck, mounted between the water tanks, is for shovels and similar tools. The truck exhaust is carried up through the right front compartment, where the air tools are carried in an upright position. This keeps the tools warm on wintry days and makes for quicker and easier handling.

Public Service uses 3-man crews for all ordinary jobs. Three men can ride comfortably in the cab of this unit. Generally, if a larger crew is needed, two crews and two trucks are sent out. With two trucks on hand, there are plenty of tools and sufficient air power to handle the job. ■

Left side compartments. Note plastic pipe rack.

Right side fitting compartments.

Small turbine power plants— 'tiger by the tail'

"THE gas industry has a tiger by the tail—a tiger that has escaped from the power companies!"

The tiger is the current use of small turbine power plants using natural gas. This description of the use of small gas turbines for industrial and commercial applications was forcefully brought out in a two-day seminar held in Houston recently. Over 150 people listened as leaders in the fields of architecture, education, gas turbines and high frequency lighting spoke on recent developments in the use of the gas turbine package.

Southern Gas Association planned and conducted the meeting. Member-companies gave full support through an unexpected large attendance. A number of companies outside SGA's area also sent representatives. Use of gas turbine power plants to supply total power, heating and cooling requirements for compact school plants, commercial and industrial buildings and shopping centers has brought a glint to the eye of the gas industry.

With the turbine power package, the gas supplier can offer the designer and owner of the modern commercial building, the shopping center or the new school plant, a power package that will provide air conditioning requirements, heating requirements and high frequency lighting for improved illumination. And all for an annual operating cost that, based upon the volume of power used and prevailing rates, may well be cheaper than the power company can sell.

Walter T. Rolfe and D. Dana Price, formerly chief engineer for the firm of Goleman & Rolfe, architects-engineers, spoke on the need for the compact school plant—a plant that will have a low first-cost and a savings on annual operating cost over the conventional school. In first studies by experts of Goleman & Rolfe seeking answers to this problem, a compact school plant was recommended using a windowless building with no interior bearing partitions and using purchased power. This unit, air-conditioned, could be built for a saving up to 20 per cent in first-cost but increased annual operating cost. Price stated they found on presenting the compact school plant to interested school boards that objections were raised to the increased annual operating costs.

Goleman & Rolfe was retained by AGA and SGA to investigate the use of an electrical and mechanical system to furnish all power requirements for compact schools. The study resulted in the development of the gas turbine power package. Use of the turbine package still meant a first-cost savings, but it also decreased the annual operating expense. And it did provide an air conditioned school plant with the added advantage of high frequency lighting.

Why the necessity for the power package?

This question may occur to you and it was answered by Price in comparing costs using the gas turbine power plant to costs using purchased power. He stated that from their study, they found the first cost savings of the compact school plant over the conventional school decreased to 17 per cent, but now a savings of $6000 per year in operating cost was realized from the compact plant*. Since the annual operating expenses for schools are paid from maintenance tax levies that in most communities are already too high, school administrators are anxious to have savings in this area as well as in low first cost.

The heart of the power package is the gas turbine. Developed and proven to a high degree of reliability, gas turbines have been operated for as many as 10,000 hr without a shutdown. The unit gives high horsepower per unit of weight. It turns at an extremely high speed, 30,000 rpm and up—extremely valuable for high frequency power generation. Exhaust gases from the turbine — having temperatures in the range of 850 deg. F—when passed through a waste heat boiler, permit generation of low pressure steam. This steam can be used with an absorption chilling unit to provide all chilled water necessary for air conditioning. In the early hours before air conditioning is required and when heating may be necessary, the steam can be used for this purpose. All requirements for water heating service in the building can also be furnished.

The power package was discussed in three general areas—gas turbine, exhaust heat recovery and high frequency lighting.

Dr. H. R. Schelp, chief engineer for AiResearch Manufacturing division of the Garrett Corp., spoke on the development of the gas turbine. Dr. Schelp stressed the need for standardization of turbine unit size, proposing the use of 300-, 400-, 600-, and 900-hp as giving flexibility for best economy. Fuel economy of small turbines cannot compare to piston engines being in the magnitude of 4500 Btu/hr for these size units.

Cost of the turbines eventually should average about $25/hp based on the 300-hp unit. The units may be expected to operate from 5000 to 10,000 hr between overhaul. Dr. Schelp stated that factory training of personnel is not required for the operation of the turbines because of their simplicity of control—the pushing of a button to start or stop. The size and weight of the turbine unit makes it particularly receptive to overhaul at the manufacturer's plant.

W. L. Moore, project engineer for the Boeing Co., stated that company personnel having automobile repair experience could be trained as turbine repairmen with two weeks of factory training.

Boeing's small turbine can be completely assembled or disassembled by two men in four hours.

Gas turbines can be operated on natural gas or liquefied petroleum gas without shutdown, giving the user an opportunity to switch to standby fuel easily. This permits the user of the turbine package to purchase his natural gas on an interruptible basis, enjoying the lower cost of interruptible rates. Continuous service of his power package would be assured by the presence of standby fuel.

The power packages used today use several small turbine units rather than concentration of horsepower in one turbine. This permits flexibility of operation in the event of trouble with one unit.

The waste heat boiler is used to recapture part of the heat contained in the exhaust gases leaving the turbine at approximately 850 deg.F. Use of the waste heat boiler permits the turbine package to enjoy a high overall thermal efficiency, on the order of 65 per cent. Low pressure steam generated in the waste heat boiler (approximately 12 psig) is used in an absorption-chiller unit to provide chilled water to flow through the air-conditioning system. A portion of the waste heat is also used to furnish hot water for showers, kitchens and other uses around the building.

The gas turbine is directly coupled to generating units. These may be either conventional 60-cycle or high-frequency generators.

Why use high frequency power —what are the advantages to high frequency lighting? This was explained to the gasmen in discussions by Don Brereton, supervising engineer for General Electric Co.; Robert H. Horner, lighting consultant of Wakefield Corp.; and Shelly Krasnow, president of Georator Corp.

Sixty-cycle power, that to most people is as relative to electricity as day is to night, turns out to be an infant in the electrical power industry. Just before the turn of the 20th century, people were using 133-cycle power generated using an eight-pole armature. Later developments resulted in the use of 25-cycle power. By 1910 and with the coming of the steam turbine generator, 60-cycle power was accepted as a compromise. Use of 60-cycle permitted the use of slower speed units and was preferable for transmission to 132-cycle. D-C power is the most efficient for transmission, but because it is limited to voltages of about 600, it cannot be used for long distance transmission.

Fluorescent lighting of today using 110-v, 60-cycle power requires the use of an inductance ballast—heavy in weight and high in heat that must be dissipated.

High frequency lighting permits use of capacitance ballast—the use of one or two small capacitors in place of heavy inductance and the elimination of high wattage across the inductance. Use of a capacitance ballast permits use of an inductance device at the power source and outside the air conditioned area. In addition, the autotransformer required for starting when operating on low voltage may be discarded when high voltage is used. Less cooling is required to overcome the decreased heating from the lighting fixtures.

As the frequency increases, lumen output of the lamps increases. Up to 10,000-cycle sinusoidal input, the lumen output of the lamp increases. It would increase above 10,000 cycles; however, use of a device operating above 10,000 cycles requires an FCC radio permit. The same fluorescent tube that is used on 60-cycle power can be operated on the higher frequency power. The tube is overdriven at the increased frequency without damage to the lamp. Wakefield Corp. has operated fluorescent lamps at 400 v and 840 cycles for 10,235 hr with a decreased output of 12.5 per cent. This may be compared to the normal 20 per cent decrease expected from the same lamp after 3500 hr of operation at 110 v and 60 cycles. The increased frequency of operation is credited with a 33 per cent reduction in cost and an increased illumination.

It has been proposed that industry accept the use of 300/600 v and 400/800 cycles as the standards for future power requirements. The use of 400-cycle power has been accepted in the military field and most military aircraft use high frequency equipment. Krasnow suggested that industry look at 420-cycle and 840-cycle permitting use of existing triplers and doublers to convert existing 60-cycle power. Use of 400- and 800-cycle may be attributed to the English whose base 50-cycle power easily multiplies into the suggested standards. The use of 420 or other multiple of 60 would simplify the use of invertors to step the frequency up or down.

There are definite advantages in the use of high frequency lighting —particularly in cost savings on ballasts and in reduction of heat. An added attraction is the lighter fixture resulting. Use of ferrite cores in high frequency ballasts reduces noises and decreases cost. Operation of the fluorescent tubes at high frequencies distorts the color slightly, but the distortion is not noticeable to the eye.

The use of high voltage can result in substantial savings in wiring costs since less copper is required.

The advantages of the high frequency system are:

1. Use of lightweight, low-loss ballasts and fixtures.
2. Freedom and flexibility in fixture design.
3. Increase in efficiency.
4. Lower operating costs.
5. More lumen output per lamp.
6. Less heat loss at fixture.
7. Lower cost distribution system.

Statistics presented on power load density in modern commercial buildings should be of interest. Expressed as volt-amperes per square foot by years:

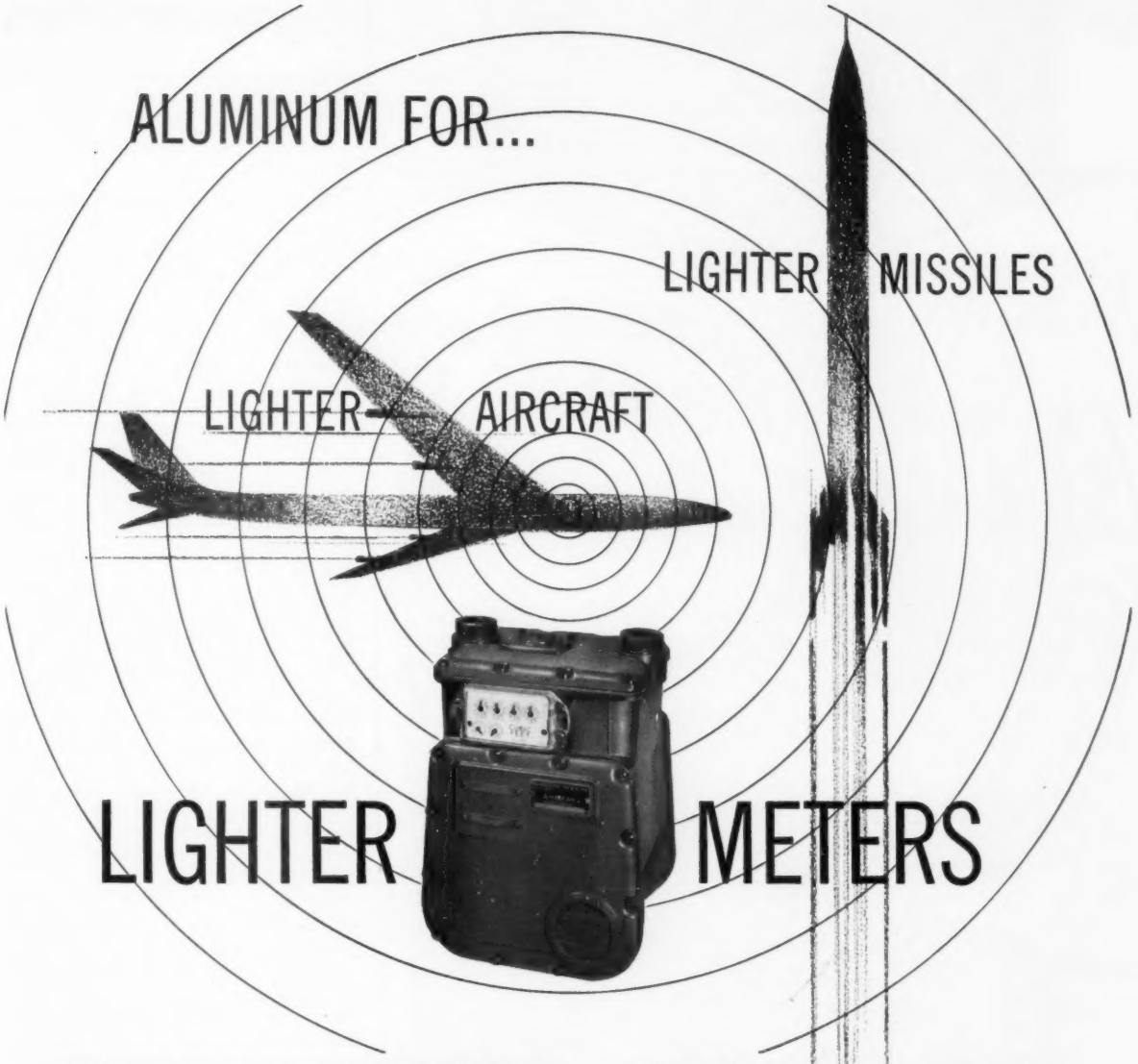
Type of Use	1950	1960	1970
Miscellaneous (Bus. machines, comp.)	0.8	2.0	5.7
Air conditioning	2.5	4.3	7.1
Lighting	4.4	6.6	9.6
TOTALS	7.7	12.9	22.4

Of particular interest in this tabulation is the rapid increase in the miscellaneous usage—attributed to the increased use of business machines and high speed computers. The increase in air conditioning is attributed in part to removal of heat from areas surrounding computers.

In conclusion, the challenge presented to the gas industry by the gas turbine power package is great —and it is a challenge that well offers to support the industry as well. For the operator of a gas turbine power plant is a dedicated user—year round. The larger the power load a customer has, the more desirable and advantageous it may be for him to have his own power plant. Whether the facility be a compact school, a shopping center or a commercial building, the rule of thumb on power load and customer-owned power plant holds true. The gas industry has the tiger by the tail—let's hope the industry rises to the occasion.

—Ken Kridner

* "A New Look at Schools"—prepared for AGA and SGA by Goleman & Rolfe, Houston.



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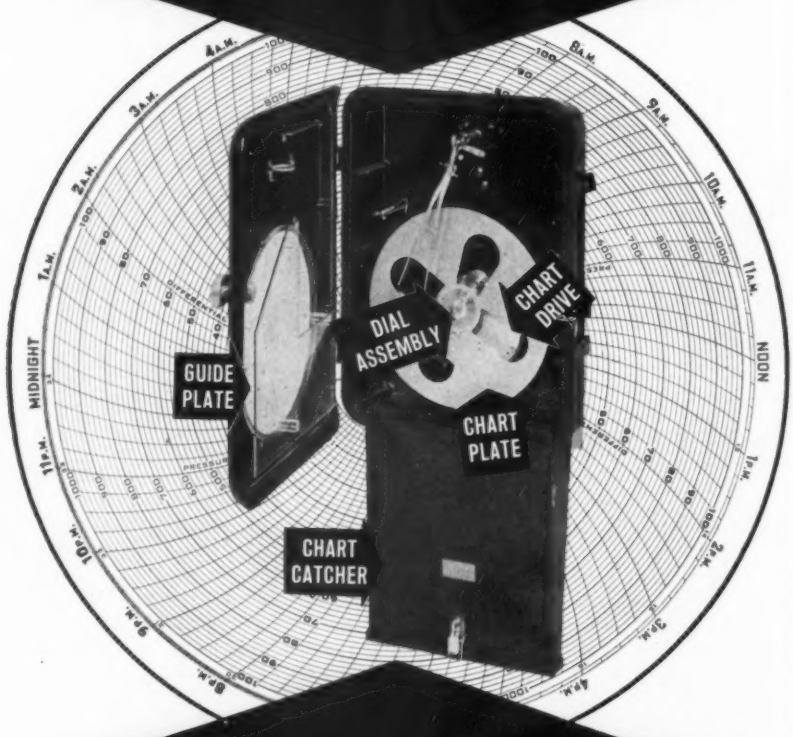

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"THE most advanced techniques in measurement control, and telemetering for gas dispatching." That was the description applied to the instrumentation and supervisory control system unveiled at the Peoples Natural Gas Co. headquarters in Pittsburgh on June 28. The system involves automatic operation of five major regulating and metering stations and has handled a peak load of over one-half billion cu ft daily to more than 270,000 customers in 274 communities in 15 western Pennsylvania counties.

Making the statement was L. B. Lumpkin, district manager for Bristol Co., prime contractor for the system. Westinghouse Electric Co. complemented the Bristol instrumentation with the supervisory controls and communications equipment. Peoples' chief engineer, H. M. Joiner, concurred on the description as did Robert E. Seymour, Peoples' vice president, when he said the $300,000 installation was "money well invested." He added, "The system has resulted in immediate dollar savings."

When asked by GAS Magazine at Peoples' press conference what it was that earned the system such praise, Lumpkin immediately cited the following: (1) security features, (2) servo-transducers, (3) digital voltmeters, and (4) the ease and clarity with which the dispatcher can read and interpret his information.

The entire system—all measurement, control, alarm, deviation, command and logging functions—operates on a digital basis throughout the network which includes stations at Vinco, McKeesport, Chalfont, Mt. Royal, and Blackhawk. Data at the dispatching center are continuously displayed on digital indicators on the control panels, just under the piping panel of the appropriate station. Also, at timed intervals or at the dispatcher's command, all readings can be scanned and logged on a daily log sheet via an IBM data logger. Incidentally, those points in alarm condition are typed in red.

Getting back to Lumpkin's first point, security and reliability have been built into the system. "With

supervisory control system unveiled

our added and expanded (piping) system, more security and safety features were mandatory," said A. F. Krause, Peoples' chief gas measurement engineer. The use of all servo transducers, a self-checking code and check-backs on all selections and control commands makes the chance of false operation very remote.

To provide accurate measurement and sufficient power for alarm and deviation signals, transducers are used for all measurements. Basically, this is a servomotor-operated instrument which measures the variable (pressure, flow, temperature, etc.) and converts it into a common electrical signal (slidewire position) for easy conversion into digital code and transmission to dispatching center.

All controlled measurement servos are equipped with deviation contacts which notify the dispatcher—via flashing lights on map panels — when readings deviate from desired control value. All pressure measuring instruments are equipped with remote set alarm contact which also notify the dispatcher—via flashing lights and audible signals — when measurements exceed desired values. The dispatcher resets these contacts to new operating conditions from his console.

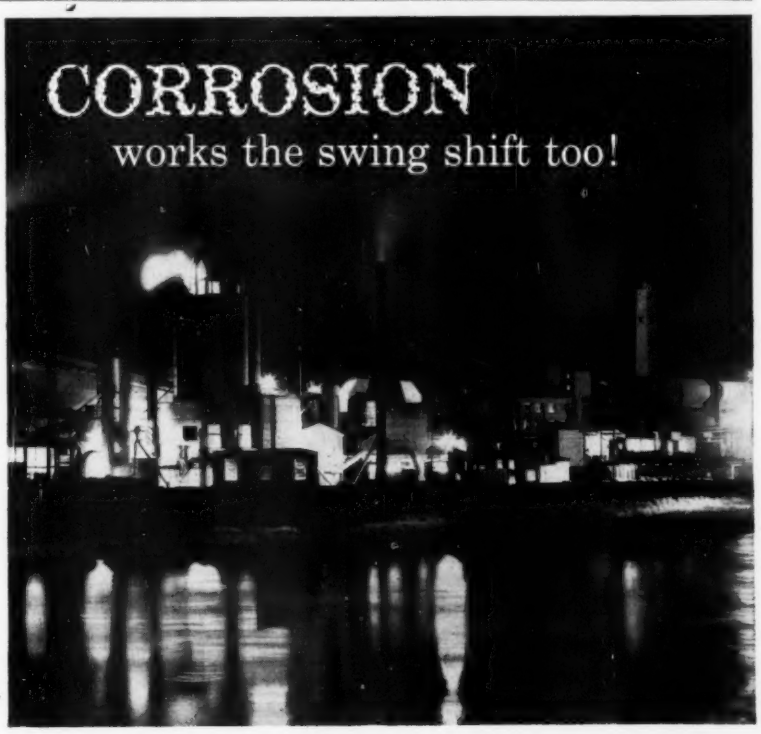
Telemetering and control functions employ a five-bit binary code with a self-checking feature. This requires the correct number of short and long bits be received as well as checking the total number of bits before passing the signal as a valid code. A further safeguard requires each selection of a control point and each information request be answered by a duplicate code before the operation is completed.

Finally, the dispatcher needs to know the condition of his supervisory and communications system. Lights on each piping panel indicate loss of communications and power to each remote station. Should electric power (purchased locally) be lost, the system will fail safe and continue to operate in the positions last requested until it is changed manually and/or repairs are made. The fail-safe feature is made possible by using gas from the lines to operate the remote controls. Each of the five remote stations can be manually controlled and will have one man on duty 'round the clock.

To reduce the number of transmitted signals and to save the dispatcher manual computations, flow, pressure and temperature readings are fed into analog totalizer computers. Thus, the dispatcher receives his total flows corrected for pressure, temperature, specific gravity, and supercompressibility.

Lumpkin's third point, digital voltmeters, converts these measurements into digital signals for tranmission to the dispatcher's office. The digital voltmeters are switched from each measured variable to another by the supervisory equipment.

The fourth point, the ease and



Thousands of miles of underground pipe feed natural gas to factories . . . other pipelines distribute oil and other petroleum products. And every foot . . . every inch . . . could corrode and leak anytime, day or night.

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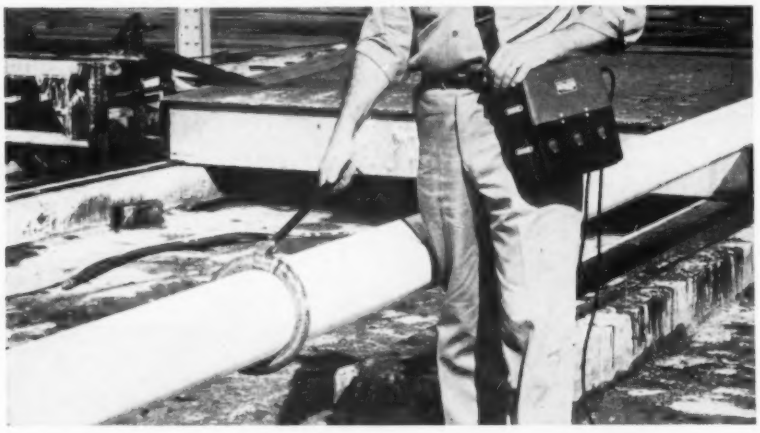

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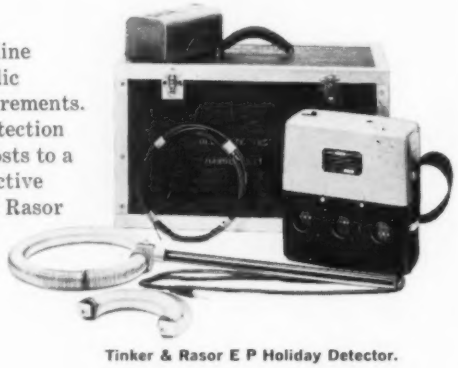
Every void in your pipeline coating increases cathodic protection current requirements. To obtain maximum protection and hold maintenance costs to a minimum, inspect protective coating with a Tinker & Rasor Holiday Detector and make repairs before backfilling.



Tinker & Rasor E P Holiday Detector.
Portable, "damp-climate" pulse type.

Write for your free Data Kit.

Tinker & Rasor has prepared a complete data kit of descriptive material and recommended procedures for inspecting protective coatings. Material includes technical data on equipment, recommended inspection procedures, general discussion of types of detectors, theory of operation, etc.

ENGINEERING NOTE:
To insure a perfect application, include Tinker & Rasor Holiday Inspection. Write for specification guide.

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clarity with which a dispatcher can read and interpret his information, is provided for in a number of ways. Digital indicators located on equipment cabinets in the dispatcher's room display continuously all the readings being transmitted. On those measurements that are remotely controlled, a digital indicator showing the set point is located immediately above the digital indicator related to the measurement.

Remote station map panels are specially designed plastic panels on the same equipment cabinets. The piping system of the station is engraved on them and, by means of signal lights and arrows, the dispatcher is kept continually informed of the condition of all the equipment shown as well as deviation points, alarm points, measurement points and condition of the communication channel.

On the dispatcher's desk is a control console which contains a common digital indicator for an individual reading on a demand basis or for following a reading closely. The console also contains a manually set digital transmitter used to set the required control value for the remote controllers as previously described.

The console also contains a series of pushbuttons which allow the dispatcher to perform the following operations: (1) Call for any reading in the system on demand; (2) up-date all indicators without a log; (3) up-date any single station's indicators without a log; (4) institute a manual log cycle; (5) select a controller and set its control point; (6) select an alarm instrument and reset its alarm contacts to a new position; (7) select and operate two-way valves in the system; (8) select and operate three-way throttling valves in the system.

With the instrumentation and supervisory controls used in this system inseparably interrelated and interlocked, the dispatcher can perform 107 functions from the Gateway Center office.

In addition, many of the Chalfont station functions are sent to and controlled from an additional dispatching center located at Pitt Street by a combination of analog and digital means. This center, operating under the direction of the main dispatching center at Gateway, handles the dispatching of gas to the City of Pittsburgh.

—By William Harper

Move to block Arkla-MidSouth merger

A minority group of MidSouth Gas Co. stockholders is trying to block the merger of MidSouth and Arkansas Louisiana Gas Co.

A suit has been filed in Arkansas' chancery court and a petition to the state's public service commission are the actions taken. The petition to the PSC asked that the commission defer consideration of the MidSouth-Arkla application for approval of the merger until the suit is decided. However, PSC approved the merger on July 5.

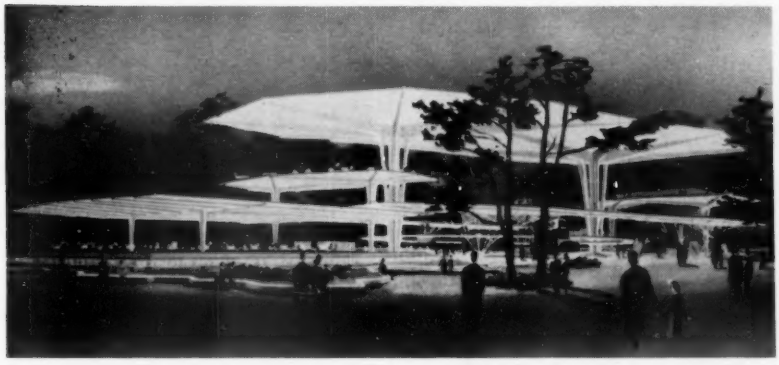
The suit challenges the merger on four main grounds:

1. That an agreement made in May by MidSouth officers and directors (defendants in the suit) for the merger was without prior notice to stockholders and was an *ultra vires* agreement—that is, beyond the scope of authority of the officers and directors.

2. That the stock exchange provided under merger terms — one share of Arkla exchanged for two shares of MidSouth — was "patently inequitable."

3. That a June 8 stockholders meeting and the action taken there were "illegal and void" because the stockholders allegedly were not given "valid notice" of the meeting and the majority of votes for merger were cast by proxy votes allegedly solicited by the officers and directors.

4. That there is no legal authority under state laws for merger of corporations.



Artist's conception of the gas industry's building planned for the New York 1964-65 World's Fair. The structure's entrance and exit will have the largest air curtain wall ever installed. A restaurant will have air walls on three sides. The major area of the building will be enclosed with plexiglas installed in such a way as to make the walls almost invisible. The canopy roof, of translucent material, permits sunlight to filter through in daylight hours. At night, it will glow with light. The 40,000-sq ft pavilion will be completely air conditioned. One of the outstanding features of the building will be an elevated revolving ring, 110 ft in diameter, which will pick up visitors at the door of the building and carry them through the building in four minutes. This will give them a preview of the building and permit them to select displays to which they would like to devote more time. Exhibits in the building will show exploration, drilling, pipeline construction, utility distribution of gas to homes, and uses of gas for commercial, industrial and residential purposes.

Peoples Gas installs direct dialing system

Peoples Gas Light & Coke Co., Chicago, has taken another step in its move to streamline its communication system and speed up phone service.

New telephone facilities make possible direct inward dialing to reach a specific person. With DID, a caller can dial an individual at Peoples Gas directly without going through the switchboard, providing he has the individual's number. Peoples Gas employees mailed cards with their individual numbers to persons with whom they are in frequent telephone contact.

Continued on page 90

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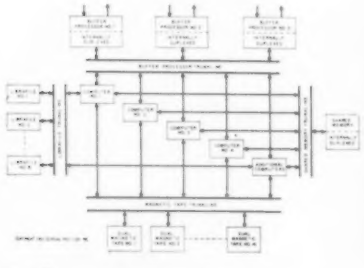
GAS DIGEST

New Products and Trade Literature

For more data on any of these items use the Readers' Service Card on pages 87, 88

1. Plugging machine

Williamson's new low-pressure plugging machine, complete with welding fixtures, isolates a section of line without interrupting flow (GEC-650). The Shortstopp plugging machine provides quick, effective pipe stop-off at working pressures to 60 psi, temperatures to 180 deg F.
T. D. Williamson Inc.

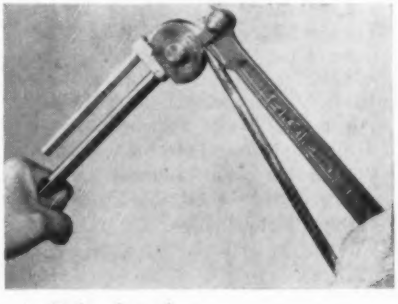


2. Computer system

The block diagram (above) shows basic organization of Librascope's new ultra-fast L-3060 distributed data processing system (GEC-180). Digital computers (center), magnetic disc files (left), buffer processors (top), and magnetic tape units (bottom), can be expanded or decreased according to problem requirements.
Librascope Div.

3. Gas analysis

Refinements in precision and packaging are features of a compact gas analysis instrument developed by American Systems Inc. (GEC-670). The lightweight, portable unit, the Austin Gas Titrator Model 3013, provides rapid measurement of the major sulfur compounds.
American Systems Inc.



4. Tube benders

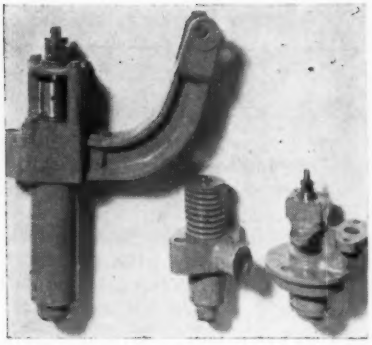
Ridge Tool has announced six sizes of tubing benders for use with soft or hard copper, aluminum and certain sizes of stainless steel tubing (GEC-650). Models 293 through 298 accommodate tubing of 3/16, ¼, 5/16, ⅜, 7/16, and ½ in. OD. They are specially designed for any application and removal.
Ridge Tool Co.

5. Data processing

IBM'S 1410 data processing, using a new adapter feature, can communicate directly with other computers (GEC-180). The 1009 data transmission unit performs the communication function. The 1410 also can communicate directly with a 1401 computer or an IBM magnetic tape terminal.
IBM Data Processing Div.

6. Patio heater

Solarflo's gas-fired infra-red radiant heater is for outdoor installation on pool decks, in patios, and gardens (GEC-420). Installation may be permanent, such as a gas light, or on portable base. The stainless steel ceramic-coated heat exchanger provides radiant heat comfort for an outdoor area.
Solarflo Co.

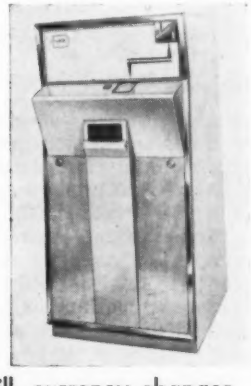


7. Fuel injection cage

Fuel injection cage assemblies are offered by Delta-Wesco for most models of Clark and Cooper-Bessemer engines (GEC-170). The cages are said to provide positive and perfect alignment of valve and seat through a series of self-lubricated aligner bushings sealed with Teflon packing.
Delta-Wesco Manufacturing Co.

8. Pipe coating

Lion Oil has developed a new pipe-coating system, a combination of asphalt coating and primer (GEC-130). Substantial savings in pipeline maintenance and electrical power costs (where cathodic protection is used) are advantages claimed for the new system. The combination is designed to overcome problems of disbonding and excessive power costs.
Lion Oil Co.



9. Bill, currency changer

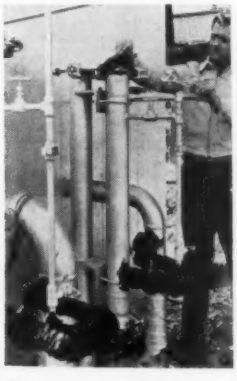
An automatic bill and currency changer uses a new electronic sensing device (GEC-600). The device scans and detects bills, and makes change for one or five dollar bills. The user places a bill in a receptacle, presses a button and waits while the bill moves into the machine on a mechanical drive through an examining sensing device.
Designers for Industry

10. Protection from dogs

A new fountain-pen size tear gas gun dispenser solves the problem of vicious dogs for meter readers, delivery men, etc. (GEC-121). Called Pengun, the 1½-oz. weapon fires an 8-ft blast of tear gas at an attacking dog, rendering him temporarily helpless. The "pen" fits easily in the palm of the hand.
Penq··in Associates Inc.

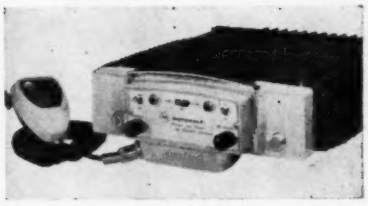
11. Pressure transmitter

Taylor Instrument has introduced its 212T series of Transcope flow and differential pressure transmitters (GEC-750). The main features of the instrument are its ability to extract the square root in flow measurement (by simple calibration), on the large-scale indicator. The 212T is a companion to Taylor's existing servo-operated pneumatic instruments.
Taylor Instrument



12. Drier pot access

Tube Turns reports that the use of its 600-lb hinged closure greatly reduces time required to open and return to service devices that dry wet gas (GEC-270). The quick-opening closures minimize the chance of freeze-up of main regulators. One company reports the time spent servicing drier pots has been cut from 40 to 10 minutes.
Tube Turns Div.



13. Noise suppression

Motorola's new Extender system suppresses ignition noise interference caused by vehicle electrical systems (GEC-140). The system widens operating range of 2-way radio systems by knocking out ignition noise interference that would ordinarily override the message in a weak signal area. It also provides more reliable reception in heavy traffic areas.
Motorola Inc.

14. Colored aluminum paint

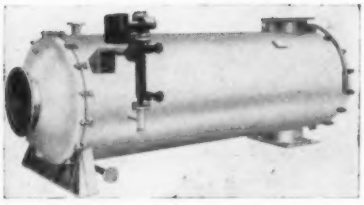
Colored aluminum paints are now available with a rust-inhibitive base (GEC-610). Subalox anodine finishes contain flake pigment in a base of chemically active suboxide of lead. It is said that the new paints are fully compatible with other existing paints and primers and will adhere firmly to weathered galvanizing.
Subox Inc.

15. Trunk-mounted radio

General Electric is adding a trunk-mounted 2-way radio to its transistorized Progress Line of vehicular communications equipment (GEC-140). A new control head half the size of previous control units has been designed for use on a car's dashboard when the basic radio is placed in the trunk.
General Electric Co.

16. Crew cab heater

The MoPeCo crew cab heater is designed for installation beneath the seat of standard crew cab bodies for utility vehicles (GEC-790). The propane-operated heater is thermostatically controlled. It keeps heat available in the cab without running vehicle engine, thus saving truck engine wear.
Morrison-Pelsue Co.



17. Exhaust heat exchangers

Engineering Controls has exhaust heat exchangers available in stock sizes (GEC-170). The exchangers are used to produce steam, heat water or process fluids in conjunction with Vapor Phase cooling systems on internal combustion engines. Available for vertical or horizontal mounting, the stock size units are designed to meet needs of any engine plant.
Engineering Controls Inc.

18. Tone multiplex equipment

New tone multiplex equipment from RCA is engineered for maximum performance and reliability in data transmission, teletype, telemetering, control and signaling functions (GEC-750). Suitable for wireline, carrier or microwave circuit use, the transistorized equipment, Type CT-42, incorporates several new features for reliable and economical operation. It provides 24 tone channels between 420 and 3180 cycles.
Radio Corp. of America

19. Shut-off valve

Security's IP-L/Temp line of automatic shut-off valves provides dual automatic safety by closing on either increasing pressure and ambient temperature, or both (GEC-820). A diaphragm senses line pressure and programs the valve into "close" position when line pressure exceeds a predetermined level. A fusible plug with a predetermined temperature setting is activated when ambient thermal point is reached.
Security Valve Co.

20. Pressure drop problems

Results of Walworth's study of flow characteristics of its lubricated plug valve have been published in a new 12-page bulletin (GEC-820). The search was for a system whereby customers might calculate pressure drops themselves. By supplying accurate pressure drop data on existing valves, systems designers may now, through the bulletin, select the most efficient and economical valve for their particular piping problems.
Walworth Co.

21. Protective coating

Protecto Wrap's No. 200 coating is described in a colorful 8-page bulletin (GEC-130). A wide variety of applications of the pipe wrap is presented, along with general properties, technical data, and pipe coverage data.
Protecto Wrap Co.

22. Malfunction detector

Application by Warren Petroleum of the latest automation techniques in monitoring equipment performance is described in a new report from Robertshaw's Aeronautical & Instrument division (GEC-200). Four-page Report V-101 outlines how Vibraswitch malfunction detectors, mounted on turbines, fans, pumps, blowers and motors, provide automatic alarm or shutdown whenever they sense impending mechanical failure.
Robertshaw-Fulton

23. Pneumatic receiver

Bristol's new Series 670 Metagraphic receiver with a 4-in. chart width is covered in bulletin A134 (GEC-750). Among features discussed are the new removable chart-drive mechanism, the capillary inking system for trouble-free recording, and the elimination of the "seal" position from the control function switch.
Bristol Co.

24. Gas scrubbers

Bulletin 601 from V. D. Anderson tells how the company's Type LDS-12-LP Hi-eF gas line scrubber was installed in a feeder main supplying residential and industrial areas to eliminate dust accumulation (GEC-720).
V. D. Anderson Co.

25. Pressure measurements

A 4-page bulletin outlines the desirable features and the utility value of a new instrument which may be used with a high degree of accuracy as a low pressure deadweight gauge or a high range differential pressure manometer (GEC-540). ToPaz claims a working pressure rating of 2000 psi for the standard model; higher pressures are available upon request.
ToPaz Inc.

26. Pressure, vacuum gauge

A new 32-page catalog C70-1a describes Honeywell's instruments for measuring, indicating, recording, and controlling pressures and vacuums involved in industrial processes (GEC-540). Specifications and data on instrument types and control systems are presented.
Minneapolis-Honeywell

27. Engine compressors

White Diesel Engine has issued a 4-page bulletin on its line of balanced-opposed engine-compressor units for continuous, heavy-duty service (GEC-160). Bulletin 989 summarizes features of the 2-, 4-, and 6-cylinder models. Construction details also are summarized in capsule form, with appropriate illustrations, dimension and specification tables.
White Diesel Engine Div.

28. Engine safety control

Catalog J from Robertshaw's Fulton Sylphon division presents 60 pages of complete information on an all-pneumatic engine safety control system (GEC-340). The catalog contains full descriptions of a number of complete systems incorporating safety shutdown or warning upon malfunctioning of measured variables such as temperatures, pressures, levels, speed, vibration, etc.
Fulton Sylphon Div.

29. Service regulators

Rockwell's 243 service regulator for gas pressure control is described in a new bulletin (GEC-700). The regulator can be rotated 360 deg. to any position to suit any type installation. Internal construction and regulator components are illustrated and described.
Rockwell Manufacturing Co.

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GAS DIGEST

30. Liquid separation film

Peerless Manufacturing has completed production of a color film strip, "Engineering Makes the Difference" (GEC-450). Short, factual and informative, the film covers the engineering, testing and manufacture of mechanical equipment for the separation of entrained liquids and solids from a vapor. The film describes various types of equipment available and their applications to various separation problems.
Peerless Manufacturing Co.

31. Air pollution

Complete information on Cenco's air pollution field test apparatus is provided in an 18-page bulletin (GEC-450). The apparatus itself is a compact, completely self-contained test unit that produces on-the-spot reports on 18 major pollutants, both gaseous and particulate.
Central Scientific Co.

32. Ventilating heaters

Morrison-Pelsue's Model PE-G and Model PE ventilating heaters are described in two catalogs (GEC-410). The propane-operated heaters ventilate underground areas. They provide a constant supply of fresh forced heated air to ventilate the manhole. They are designed for year-round use under a variety of weather conditions.
Morrison-Pelsue Co.

33. Three-way valve

A versatile pneumatic circuitry component, Mite 75, is described in a bulletin from Dahl (GEC-750). Complete specifications and operational data are given on the diaphragm-operated, snap-acting three-way valve.
G. W. Dahl Co.

34. Hydraulic control pilot

Atlas Valve's 811 hydraulic control pilot, designed for extremely accurate control of diaphragm valves, is the subject of a 2-page catalog sheet (GEC-200).
Atlas Valve Co.

35. Post heating

A technical paper on automated motor rotor post-heating and shrink-fitting has been published by Selas (GEC-400). The 4-page, illustrated paper discusses reasons for post-heating die-cast aluminum rotors, describes equipment and methods for automatic processing to improve rotor efficiency and upgrade quality.
Selas Corp. of America

36. Pool heater

Hydrotherm's Pleasur-Temp indirect pool heating system is covered in Bulletin HYF-234 (GEC-860). Dimensions and weights are presented along with a selection chart showing the model needed for various pool sizes based on temperature rise needs.
Hydrotherm Inc.

37. Indicators

Thermo Electric's Bulletin 67 describes its Thermo Electronic indicators and indicating controllers (GEC-200). The instruments provide rapid, accurate, automatic indication and/or control of a wide variety of industrial processes.
Thermo Electric Co.

38. Diaphragm valves

Eight types of air operators for Hills-McCanna diaphragm valves are described in Bulletin 134-A (GEC-820). The valves are recommended for remote and automatic flow control of a wide range of corrosive and non-corrosive liquids and gases.
Hills-McCanna Co.

39. Plastic caps

A bulletin from Protective Closures Co. describes new larger size protective polyethylene caps and sleeves (GEC-630). They are designed to protect threaded shafts, drill pipe, and other products and components of relatively large diameter or odd shape.
Protective Closures Co.

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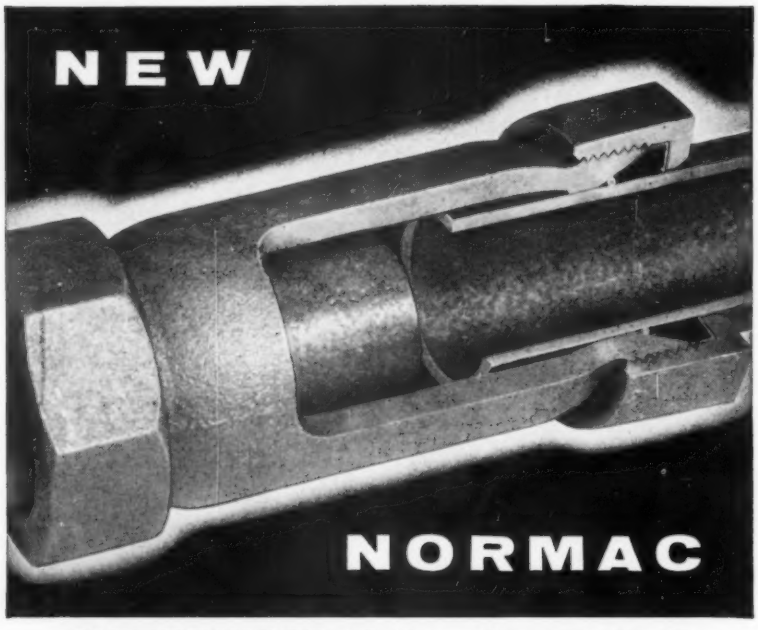

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Provides More Deflection Than Ever

Engineered in line with latest data on distribution pressures and installation ease. Inspect its construction and quality materials in detail. (Available with Normac INSULATING gaskets).

BRASS FITTINGS
IRON BODY COCKS
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METER BARS
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MALLEABLE SERVICE ELL
Maximum stab. All sizes, with or without insulating gaskets. Also in brass 1¼ I.P.S.

BRASS FITTINGS
The most complete line for copper or plastic tubing in ⅝, ⅞, 1⅛, 1⅜ O.D., 1¼ I.P.S.

Top Quality for 22 Years in Gas Distribution Equipment

Get helpful CATALOG 12. Photos, specs, detail drawings & much helpful data for modernizing or new installations.

PERMANENCY Rely on NORTON-McMURRAY for the finest! NORMAC continues to modernize and improve couplings and fittings in step with latest gas distribution demands. 22 years experience concentrated on ONE purpose . . . the BEST! Today, major gas distribution companies say "NORMAC" to define their standard of quality.

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PIPE STOPPERS OF ALL KINDS

SAFETY GAS MAIN STOPPER CO. INC.

GOODMAN
USED SINCE 1897
2" HANDLE & LOCKING SLEEVE
GAS MAIN STOPPER

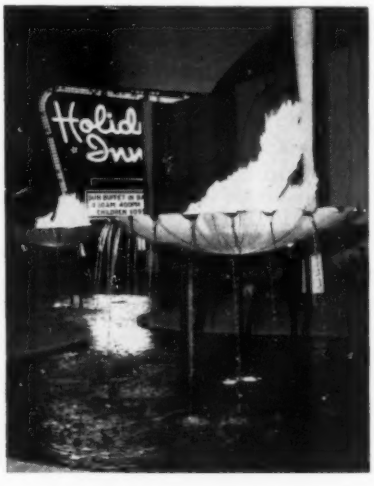
523 Atlantic Avenue
Brooklyn 17, N. Y.
Cable Address GASTOPPER, N. Y.

14th rate reduction sought by Consumers' Gas

Consumers' Gas Co. has applied to Ontario Energy Board for approval of its plan to reduce natural gas rates to home, municipalities, business and industry by $1 to $1.5 million annually.

This is the 14th voluntary rate reduction since natural gas replaced manufactured in Consumers' system in 1955. President and general manager Oakah L. Jones said the total of the 14 annual rate reductions during the last six years has been nearly $10 million.

Major reduction of nearly $25 per year goes to residential customers whose homes are fully equipped with natural gas for central heating in conjunction with three other gas appliances.



Gas flames and water fountains helped this Dallas motor hotel boost business by 300 per cent. Located in front of Holiday Inn Central are two cleverly designed water fountains with gas flames dancing on the water's surface. The elevated metal bowls stand on pipe legs about 5 ft above a figure-8 shaped pool of water. Water is pumped into the bowls, then cascades over the sides. Lone Star Gas Co. supplies the gas that is piped into a metal ring submerged in each bowl of water. The gas escapes through holes in the rings and its pressure causes the water's surface to bubble, thus adding to the effect. A pilot light arrangement ignites the gas as it comes to the surface, then flames rise to a height of about 3 ft.

Oven cooling system introduced

AN amazingly simple, yet heretofore unapplied idea, was one of the more striking features of a new gas oven control introduced by the Wilcolator Co. at a press conference in New York City on July 6. That unique feature is a "gourmet fan" that will cool off the interior of an oven to remove the latent heat from it and the meat, thereby preventing a rare roast, for instance, from continuing to cook from its own heat and that heat which ordinarily would be retained within the oven.

That was just one of the features of the oven control which, according to Wilcolator's executive vice president John H. Gantlin, is "the most revolutionary advance in gas range cooking in the past 25 years." He also said that one of the prime features of the control, which will be on 1962 model ranges, is that it will make "programmed cooking" a reality. That feature allows the housewife to place a frozen roast or casserole into the oven, set the controls for a fast or slow defrost, have it cooked to exactly the right temperature, and hold it there until needed.

Patrick E. McCoughey, the company's general sales manager, said the unit combines all the "plus" features of previous gas oven controls and added that several significant new ones make it a major breakthrough in oven control. Those other features include:

1. Indicators telling when pilot is out; oven is on; when it is ready, when it is warming.
2. 100 per cent pilot shutoff.
3. Elimination of tubing or fitting to thermostat.
4. No critical re-ignition of burner.

Even with these and other features, the new control will be available to gas range manufacturers at a reduced cost, according to McCaughey.

When asked by GAS Magazine if the company has given any thought to applying the principles of thermoelectricity to the controls, it was stated that Wilcolator did not feel "the state of the art" had been advanced far enough at that time to be considered for the new unit.

—William Harper

Arkansas Louisiana in acquisition move

Arkansas Louisiana Gas Co. is now entering the manufacture and fabrication of gas power generation equipment. Its wholly owned subsidiary, Arkla Air Conditioning Corp., has agreed to buy most of the assets of the Ingersoll Corp., Shreveport, producer of natural gas-driven generation assemblies.

Arkla president W. R. Stephens said the purchase price was $75,000 for land and building, not including inventory.

About a year ago, Arkansas Louisiana established a full-time power generation sales department. The Ingersoll purchase "is a logical follow-up to our previous activities . . .," Stephens said. The new division will expand the company's emphasis, both regionally and nationally, on the increasing use of gas-operated engine units for independent production of electric power by commercial and industrial consumers.

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Austin Recording Gas Titrator Model 4010

The fully automatic Austin Gas Titrator 4010 is designed for continuous on-line measurement of sulfur in natural gas and plant process streams. Developed for corrosion and odorant control analysis in transmission and distribution systems, the 4010 continuously records on a strip chart its analysis of sulfur compounds. This accurate, reliable analytical instrument is adaptable to virtually any installation in the natural gas, LP gas, petrochemical, and chemical processing industries.

ANALYSIS CYCLE:
Complete analysis and recording of major sulfur constituents once each hour

RANGE (H_2S):
0 to 0.5, 0 to 2.5 grains/100 SCF Full Scale

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AN AFFILIATE OF SCHLUMBERGER

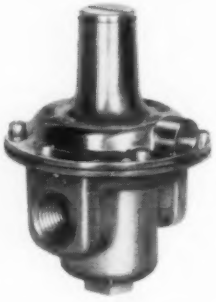
Builds new service center

Under construction and slated for completion next April is Northwest Natural Gas Corp.'s new service center in Portland, Ore. The three-story, 90,000-sq ft building will house the accounting department as well as other clerical departments, the sales department, and the operating department. The company recently moved into its new downtown headquarters building, which houses Northwest's executives and staff and business office.

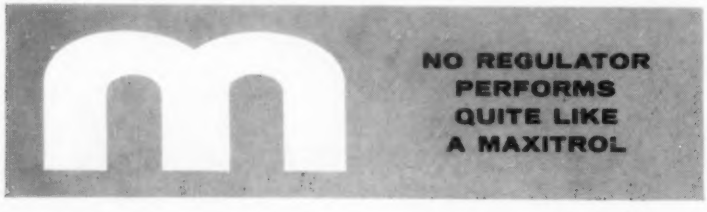
This giant "band shell" is really the upper diaphragm chamber of a Maxitrol gas appliance pressure regulator. You can practically play a tune on the adjusting spring, for its made from music wire, the finest available for this application. No permanent set occurs under full compression. The spring is cadmium plated for corrosion resistance.

At the back is the Buna-N-coated nylon diaphragm. It's quality rolled and cured for maximum flexibility and will withstand up to 45 psi, as much as 10 times the pressure expected in extreme service. Also at the rear is the breather hole.

Select any Maxitrol regulator from any production lot, open it, examine the carefully engineered and manufactured components. Then, you'll see why you've selected the finest appliance regulator made.



MAXITROL COMPANY, 23555 TELEGRAPH ROAD, SOUTHFIELD, MICHIGAN



Potter outlines dollar needs

From $10 to $15 billion will be needed in the next decade by the expanding gas industry to help finance construction of facilities. AGA president L. T. Potter told the New York Society of Security Analysts that the money will come from Wall Street and other outside sources.

"We expect that both our annual construction expenditures and our gross plant will more than double in the next 10 years," Potter said. Gross plant for gas utilities, including pipeline companies, was $21.8 billion at the start of 1961. During the Fifties, $14 billion was spent by these utilities on construction.

With the tremendous growth in the next decade, Potter noted, must come solution of problems concerning regulation of the industry. "It is fair to say that no one works in or with the gas industry very long today before he realizes that the regulatory problem looms large in its bearing upon our industry's well-being."

Because of its concern over the regulatory problems, AGA has a committee of top gas utility executives reviewing and analyzing the situation and recommending solutions. Potter explained that the committee has concerned itself mainly with suggestions on how to eliminate delay, which it believes is the fundamental problem.

The committee's report falls into two parts. One is concerned with procedural and administrative problems which can be resolved without legislation. The other deals with matters which can be solved only through legislation. Potter said the most important recommendation in the latter part involves certain reorganizations of the FPC and its staff so that they can more effectively cope with the workload.

United fights loss of customer

On July 5, United Gas Corp. filed suit in the Travis county state district court against the Texas Railroad Commission, the City of San Antonio, and Alamo Gas Co. United brought the action after the commission said it was without jurisdiction to arbitrate United's protest.

United Gas Corp. asked Texas Railroad Commission to prevent newly formed Alamo Gas Supply Co. from serving the city of San Antonio.

San Antonio declined to renew its contract with United, which has been wholesaling gas to the city's municipal utility since 1922. The city awarded the 20-year contract to Alamo, formed last year by seven independent oil operators and an automobile dealer.

Under the plan, Coastal States Gas Producing Co., Corpus Christi, will sell about 50MMcfd of its own gas to Alamo. Another 37.5 MMcfd will come from Rio Grande Valley Gas Co. and its subsidiary, Hope Production Co., Brownsville.

United officials charged that they had offered San Antonio's City Public Service Board a 20-year gas supply contract calling for a fixed price during the first five years. The contract "would result in a saving during that period of $5.6 million for the city."

United charged that the fixed price in the Alamo contract is "illusory and meaningless." And, "past experience has shown that because of the rising cost of gas in the field, inflation and other economic factors, it is completely unrealistic to forecast a price at which gas can be sold at the city gate for more than five years in advance."

United's attorney, Carl Wright Johnson, said that the mere desire by the city to "obtain its gas requirements from another supplier is not sufficient or proper reason for permitting such other supplier to come into the area already adequately served and to duplicate United's existing facilities and services, bringing about destructive economic waste."

United also charged that if it does not continue serving San Antonio, its costs of service to 55 other cities and towns in the area "will materially increase, and higher rates to those cities and towns will be required."

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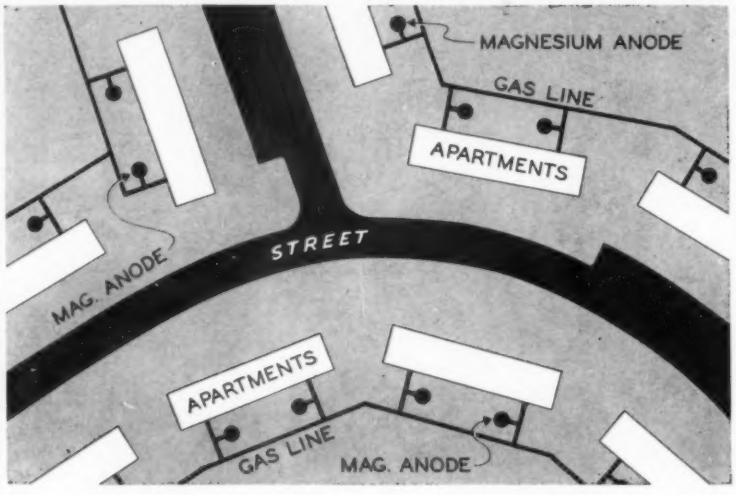
Howard Magnuson (left), general sales manager for Honolulu Gas Co., receives trophy for the best designed booth at the Home Builders Association Home Show held in Honolulu. Barbara Levy, queen of the show, made the presentation. On the right is Francis Y. Wong, president of the Home Builders Association of Hawaii. Honolulu Gas' exhibit featured a Miracle of Flame kitchen in sunshine yellow inside the patio structure. Outside a gas flame emerged from the pool rock garden and gas luau torches suggested the relaxed living possible with gas appliances.



LEAKS IN GAS LINES STOPPED AT HOUSING DEVELOPMENTS

The management of three Ohio housing developments was faced with an increasing number of leaks in the gas lines serving the apartments. External corrosion was found to be the cause, and CSI was awarded a cathodic protection contract on a bid basis.

To stop the corrosion, CSI engineers installed 17-pound magnesium anodes. The anodes project a protective electrical current onto both the 2-inch lines leading into the individual apartments and the larger distribution lines. More than 350 anodes, pre-packaged with backfill in cloth bags, were used. Protection was designed for 10 years.

CSI furnished the anodes plus all necessary labor and equipment—augers, ditchers, etc. Some anodes were installed under concrete and blacktop. In all cases, installations were made to the inspectors' satisfaction.

It will pay you to check with CSI engineers. They offer expert engineering and installation services — to stop corrosion on pipelines, gas well casing, tank bottoms, etc. Also quality supplies for both rectifier and magnesium anode installations.

CSI

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Cleveland 13, Ohio
1309 Washington Ave.
Tel. CHerry 1-7795

Mailing Address:
Box 787, Sand Springs, Okla.
Tel. Circle 5-1351

Water heater rentals succeed at Citizens

The thousandth commercial gas water heater to be rented by Citizens Gas & Coke Utility has been installed in an Indianapolis laundry.

Citizens Gas has been renting Ruud heavy-duty units for the past 5½ years.

The customer's only obligations are to pay modest rental fees that start at $9 a month, and the gas bill. The utility is responsible for correct water heater sizing so that all requirements will be completely met. No charge is made for installation, periodical inspection, maintenance or repairs. Further, the customer can end the rental agreement on 30 days' notice. The water heater is removed by the utility without charge to the customer.

Other utilities renting Ruud commercial water heaters now include Florida Public Utilities Co., City of Clearwater Municipal Gas Department, Tampa Gas Co., West Florida Gas Co., all in Florida; Piedmont Natural Gas Co., North Carolina; Wachusetts Gas Co. and Brockton-Taunton Gas Co., Massachusetts; Providence (R. I.) Gas Co.; Washington (state) Natural Gas Co.; and in Canada, Quebec Natural Gas Co., Consumers' Gas Co., and Union Natural Gas Co.

N. C. may cut taxes

North Carolina is studying two proposals seeking to lower the state's gross receipts tax on natural gas sold for industrial and agricultural purposes.

The plans would reduce the tax from 6 to 1 per cent. Backers of the legislation say it is needed if the state is to maintain competitive power rates for industry.

Gas-fired fountain saves thirsty golfers

Lone Star Gas Co. has developed a gas-fired, self-contained refrigerated drinking fountain for hot, thirsty Dallas golfers.

L. B. Houston, director of Dallas parks and recreation, challenged Lone Star to develop a fountain for installation where power outlets were unavailable or impractical.

Lone Star research engineer Ed Muehlhause responded by converting a 12-ft Norge refrigerator into a prototype model of the gas-fired fountain. A large fiberglass water storage tank, designed to hold an ample quantity of cold water, was installed inside the refrigerator's food compartment. A set of copper coils, through which the drinking water passes under pressure, was placed in the tank's bottom. The unit's refrigeration coils first cool the water in the storage tank, which then cools the water flowing through the copper coils.

Controls keep the fountain operating between 38 and 55 deg. F. To conserve refrigeration, a precooler takes waste water from the fountain's bubbler and runs it through the unit's heat exchange system.

Fuel system for the fountain consists of two 100-lb bottles of propane located in the rear of the refrigerator. Muehlhause estimates the drums could supply fuel for 70 full days of 24-hr operation.

American Gas Co. finances expansion

American Gas Co. has completed over $800,000 in new financing which will enable it to expand its gas system.

The company provides natural gas service to Carter Lake, Iowa, and expected to complete construction in three Missouri towns by Aug. 1. Norman Hahn is president of American Gas and also heads American Propane Gas Co.

Gas transmission, distribution and service lines are being constructed in Rock Port, Tarkio and Fairfax, Mo. The new financing also will go for part of the cost of a propane-air standby plant in Carter Lake; for development costs for natural gas service in Craig, Mo., Sidney, Tabor and Hamburg, Iowa, and in 13 north-central Wisconsin towns.

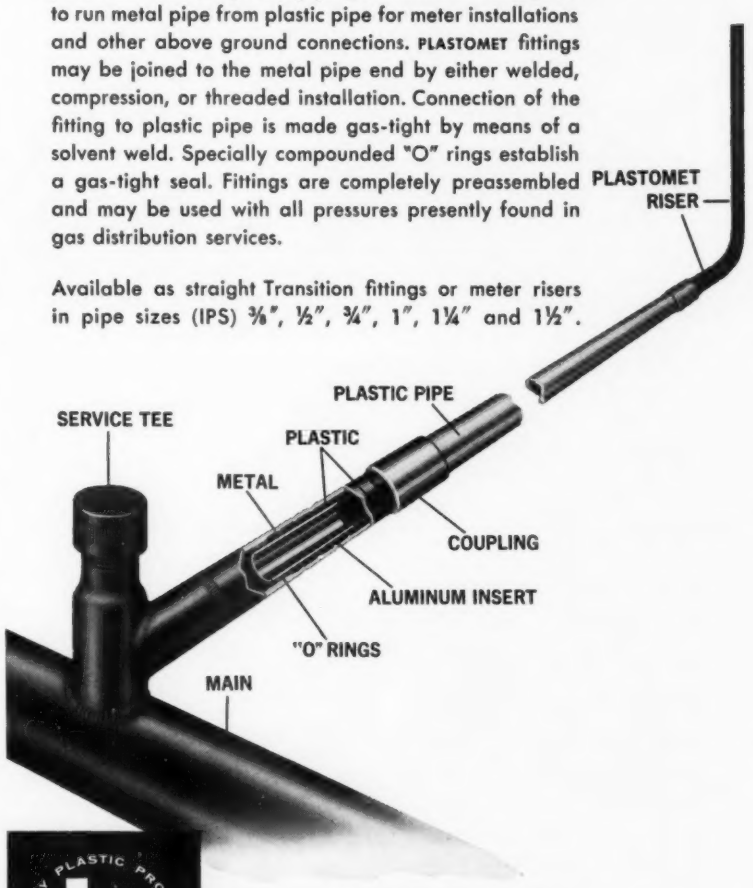
Kraloy finds the Missing Link...

"PLASTOMET"

Plastic to Metal Transition Fittings for gas distribution installations

Improved **PLASTOMET TRANSITION FITTINGS** offer a superior, uncomplicated, and safe method of joining plastic pipe to steel mains. These specially designed fittings make it possible to connect plastic piping to metal main lines, and to run metal pipe from plastic pipe for meter installations and other above ground connections. **PLASTOMET** fittings may be joined to the metal pipe end by either welded, compression, or threaded installation. Connection of the fitting to plastic pipe is made gas-tight by means of a solvent weld. Specially compounded "O" rings establish a gas-tight seal. Fittings are completely preassembled and may be used with all pressures presently found in gas distribution services.

Available as straight Transition fittings or meter risers in pipe sizes (IPS) ⅜", ½", ¾", 1", 1¼" and 1½".



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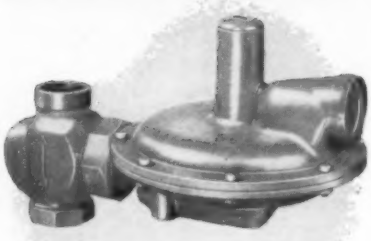

For every domestic installation

ADAPTABILITY

Reliance Series 1400 Regulators are available in a wide variety of models. Designed for convenient installation, inspection and maintenance where space limitations are encountered.

VERSATILITY

Union-type, removable pipe section simplifies installation. Full 360° rotation of diaphragm section gives complete piping flexibility. Detachable meter bar available for compact, easy installation.

DEPENDABILITY

Manufactured in conformance with ASA Code B31.1.8-55. Maximum inlet pressure 125 psi.

See Bulletins 100 and 102.1 for details.

AMERICAN METER COMPANY

Sales Offices in Principal Cities

NEWS

NI-Gas to generate lights from gas in new buildings

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Natural gas will be burned to power a series of turbines that will drive generators to produce high frequency electric current. Marvin Chandler, president of NI-Gas, said the system "should provide us with better lighting at lower cost than conventional methods."

Six EDP systems head for Public Service

Six of RCA's all-transistorized electronic data processing systems will be installed at Public Service Electric & Gas Co.'s headquarters in Newark, N. J. Lease agreement calls for one RCA 601 and five RCA 301 systems.

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Public Service will be the first gas and electric utility to use the new 601 system, described as the world's fastest business computing system. RCA's Donald H. Kunsman said that "in effect, the smaller systems (the 301's) will serve as satellites for the big one, feeding it information, digesting information for it, and printing at high speed the results of its computing work."

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A LEAK IN THE DIKE

Southern Cross Corp.—like the little Dutch boy, keeps "its finger in the dike" for the gas distribution industry. Like a leak in the dike, unaccounted for grows and grows. Our "Contract Leakage Control Service," both survey and repair, can supply expert help as you need it . . . when you need it without costly build-up of personnel and equipment. For complete information about SCC Leakage Control Service, call collect.

SOUTHERN CROSS (SCC) CORPORATION

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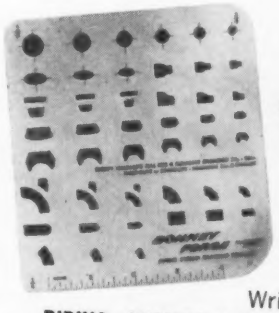

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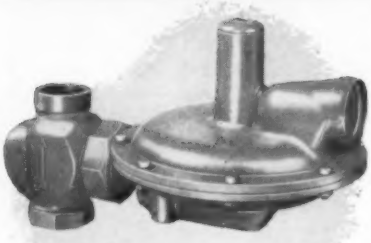
SERIES 1400 REGULATORS



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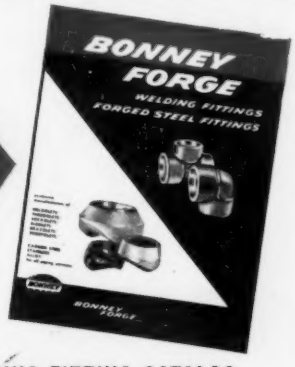

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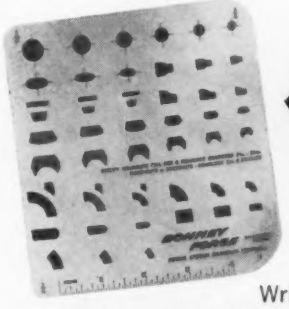
NEW 1961 BONNEY FORGE WELDING FITTING CATALOG
Weldolets® • Thredolets® • Sockolets® • Elbolets® • Brazolets® Sweepolets® . . . in carbon steel, stainless and alloy for all piping services.



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Write today for this ingenious **FREE**
PIPING SYSTEM WELDING FITTING DRAWING TEMPLATE
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BONNEY'S NEW FORGED STEEL FITTING CATALOG
No. FSF2-1961. The cleanest, best looking, highest quality Forged Steel Fitting line on the market today.

Send for one . . . send for all, today!
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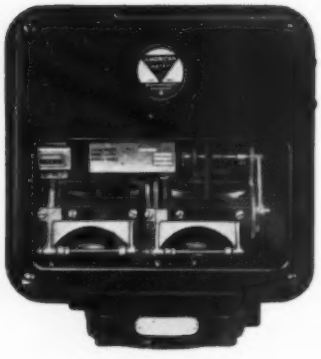
BONNEY FORGE AND TOOL WORKS
ALLENTOWN, PENNSYLVANIA

BASE VOLUME INDEX



Accurate flow volumes at all times

American® Base Volume Indexes register the measured gas quantity at standard conditions of base pressure and base temperature on a direct reading counter. No computations... accurate gas volumes are shown continuously and immediately.

A second counter also indicates the gas volume at line conditions. Simple operating principle... integration is continuous with all functions performed mechanically through special gearing.

Write for Bulletin 200 for complete information.

AMERICAN METER COMPANY

Sales Offices in Principal Cities

GAS ASSOCIATIONS

Michigan gasmen elect Adams

Frank B. Adams, manager of Consumers Power Co.'s Jackson division, is the newly elected president of the Michigan Gas Association. Serving with Adams as vice president is Karl E. Schmidt, vice president and engineer of Michigan Consolidated Gas Co., Detroit.

Serving his ninth term as secretary and treasurer of the association is Milton G. Kendrick, administrative assistant to the vice president in charge of sales for Michigan Consolidated.

Oakah Jones heads Canadian gas group

Canadian Gas Association's new president is Oakah L. Jones, president and general manager of the Consumers' Gas Co., Toronto. He was elected during the association's 54th annual meeting held recently at the Banff Springs hotel. He succeeds R. C. McPherson, senior vice president of Canadian Western Natural Gas Co., Calgary.

J. W. Ostler, president and general manager, Canadian Meter Co., was named 1st vice president; D. Cass-Beggs, general manager of Saskatchewan Power Corp., is 2nd vice president.

Smoker heads AGA nominees

United Gas Improvement Co.'s president E. H. Smoker has been nominated for president of the American Gas Association. Elections will be held Oct. 4, during AGA's 43rd annual convention in Dallas.

Smoker, currently 1st vice president of the association, is among 31 gas industry executives nominated to serve as officers, directors and section chairmen in 1962.

Chairman of the general nominating committee is W. E. Mueller, president of Colorado Interstate Gas Co., Colorado Springs.

Save Valuable Engineering Time on

NETWORK FLOW PROBLEMS

Computations Southwest, as Ling-Temco's complete digital computing facility, is designed to reduce costly engineering manhours to minutes of computing time. For the gas industry, it offers invaluable aid in solving problems involving network flow and piping flexibility.

Computations Southwest gives you a complete package — consultation, programming, machine operation and liaison services, all or part — either on-site or off, on a per job or per hour basis. And we are equipped to handle data by mail, teletype, telephone or messenger. Many such programs are already available from our program library. New problems receive quick-action diagnosis and programming for immediate answers.

Major companies throughout the Southwest have realized substantial economies in time and money by using Computations Southwest to solve their scientific and commercial problems. Its programming staff has a wide range of experience, including large-scale weapon system analysis, vibration and dynamics systems analysis. For more information, call or write Alton Ashworth, Senior Operations Research Engineer.

Computations Southwest

LING-TEMCO ELECTRONICS, INC.

P. O. Box 6191 • Dallas 22, Texas
Phone BRoadway 6-7111

GAS • PEOPLE

Cecil Loomis
Columbia

John Partridge
Columbia

James Phillips
Charleston

W. P. Dick
Charleston

CECIL E. LOOMIS has been elected vice chairman, and JOHN W. PARTRIDGE president of the Columbia Gas System Inc. Partridge also was elected a director of the corporation. Loomis, who will continue as chief administrative officer, has served as a director since 1956 and as president since May 1960. Partridge has been president of the Charleston Group companies since 1951. Two other Columbia officers advanced in rank. FRED W. BATTEN, vice president and chief operations officer since June 1960, is now senior vice president and chief operations officer, and a director. FRANCIS H. CRISSMAN, a director since 1956, was elected senior vice president and chief financial officer.

Following John W. Partridge's elevation to president of the Columbia Gas System, JAMES S. PHILLIPS was named president of the Charleston Group companies. Since 1953 he has served as vice president and general manager of United Fuel Gas Co. and other companies of the group. W. P. DICK, vice president of the Charleston Group since 1952, succeeds Phillips as vice president and general manager.

PLICO

pipeline insulating products

TYPE 640
MOLDED
CASING SEAL
PROVIDES 3 EXTRA ADVANTAGES

Because of three superior features, PLICO CASING SEALS *keep insulated carriers dry...permanently!*

1. **Extra thickness reinforces shoulder, prevents cuts and tears.**
2. **Stainless steel bands and worm gear clamps resist corrosion.**
3. **Molded to fit true nominal pipe size without wrinkling, yet stretches to fit over heavy coatings too.**

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A DIVISION OF MARWAIS STEEL CO.
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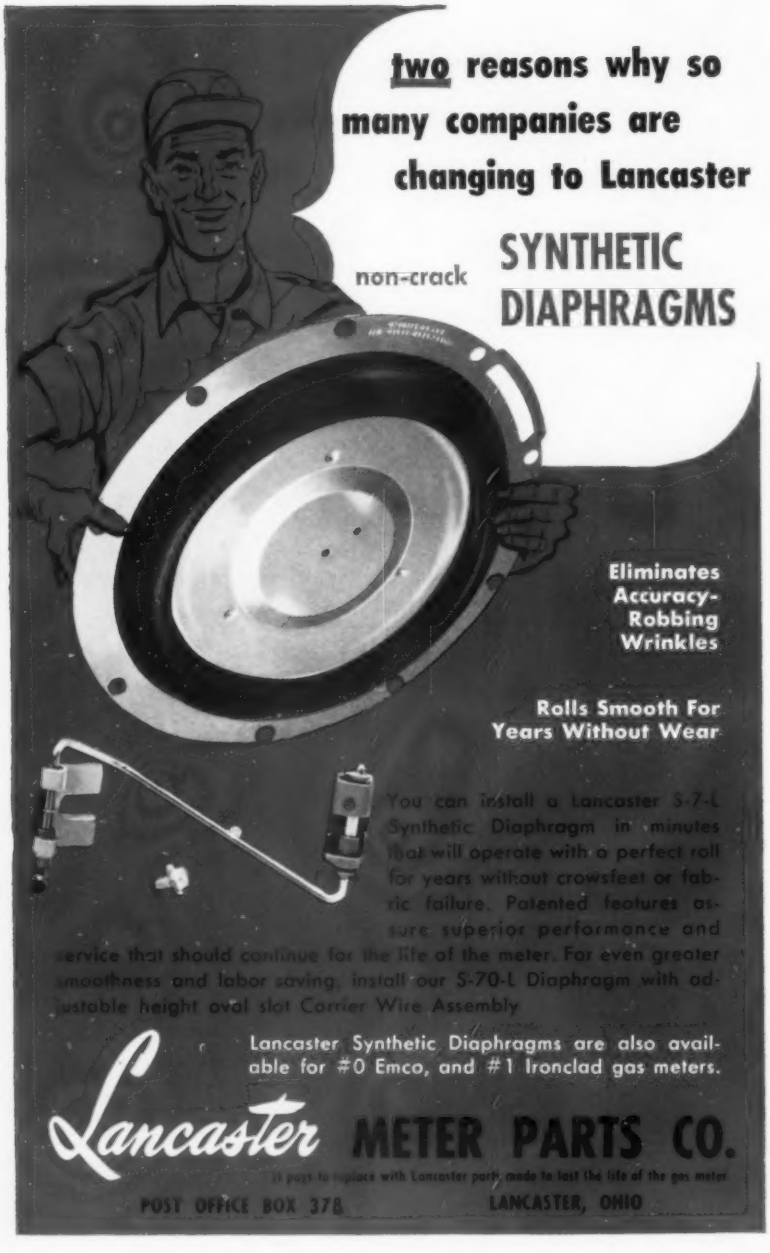
two reasons why so many companies are changing to Lancaster
non-crack
SYNTHETIC DIAPHRAGMS
Eliminates Accuracy-Robbing Wrinkles
Rolls Smooth For Years Without Wear
You can install a Lancaster S-7-L Synthetic Diaphragm in minutes that will operate with a perfect roll for years without crowsfeet or fabric failure. Patented features assure superior performance and service that should continue for the life of the meter. For even greater smoothness and labor saving, install our S-70-L Diaphragm with adjustable height oval slot Carrier Wire Assembly
Lancaster Synthetic Diaphragms are also available for #0 Emco, and #1 Ironclad gas meters.
Lancaster METER PARTS CO.
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Firm _____
Street _____
City _____ Zone _____ State _____

PEOPLE

W. H. Gilmore
Robertshaw

T. J. Ingersoll
Robertshaw

Newly elected vice presidents of Consolidated Edison Co. of N. Y. are ARTHUR N. ANDERSON and WILLIAM C. BEATTIE. Anderson will have responsibility for the construction activity in the streets and also transportation throughout Con Edison's service area. Beattie, with the company since 1927, is in charge of the company's electric, gas and steam production facilities. FRANCIS A. GOING is now auditor of Con Edison.

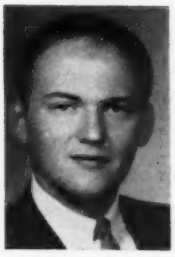
RON IFOULD appointed company sales representative for Western Europe by Ridge Tool International Co., Inc. Ifould headquarters in Paris.

W. L. PRINGLE is newly elected vice president of Motec Industries, Inc., for the Minneapolis-Moline Farm Equipment and Mocraft Power Tool divisions of the Hopkins, Minn.-based company.

EARL CUNNYNGHAM appointed district geologist in charge of Arkansas Louisiana Gas Co.'s newly opened Oklahoma district geological office in Oklahoma City.

G. K. SINKINSON, appointed to staff of Hays Manufacturing Co., Erie, Pa., as salesman for the New York area, including New Jersey, Long Island, and southern tip of Connecticut.

Robertshaw - Fulton's Grayson Controls division, Long Beach, Calif., announced appointments of JOHN C. LOWE, product sales manager for water heater controls line, Long Beach; DAVID A. BODINE, sales representative, Kansas City; HAYDEN E. ROBERTS, JR., sales representative, Chattanooga; WILLIAM K. RAE, sales representative in Chicago area.



D. P. Faulhaber
Robertshaw

R. F. Ogborn
SoCal

Robertshaw-Fulton Controls announced the appointments of JOSEPH A. HOWELL, JR., to general solicitor for the controls firm, and AUZVILLE JACKSON, JR., assistant general solicitor, patents. Both men headquarter in the Richmond offices.

R. F. OGBORN promoted to manager of real estate and industrial engineering for Southern California Gas Co., Los Angeles.

JOSEPH T. DONAHUE is in charge of the newly opened office of United States Pipe & Foundry Co., Buffalo, N. Y.

Four new district sales managers for Robertshaw-Fulton's Grayson Controls are WILLIAM H. GILMORE, St. Louis, Mo.; THOMAS J. INGERSOLL, Chicago; DONALD P. FAULHABER, Haddonfield, N. J.; WILLIAM B. JOHNSON, JR., Atlanta, Ga.

EDGAR A. GAUDETTE is now vice president and treasurer of Neptune Meter Co., New York; PAUL S. WELLS is general manager of Neptune's electronic division in Wallingford, Conn.; and WILLIAM L. PERKINS is sales representative for Neptune Meter in Louisville, Ky.

E. A. BRUGGER has accepted a new position with Koehring Co., Milwaukee, in connection with its overseas and European activities. CHARLES E. PETOT is district representative working out of Cleveland.

Cascade Natural Gas Corp. appointed JAMES B. LEDFORD superintendent of operations for the eastern division.

NEW BARTON 273 PNEUMATIC TRANSMITTER MEETS MORE APPLICATION REQUIREMENTS THAN ANY OTHER TRANSMITTER

The Barton 273 offers the widest differential pressure ranges (0-8″ w.c. to 0-400 psi), the highest safe working pressures (to 10,000 psi), and the widest variety of housing materials (aluminum, brass, steel, 316 stainless steel). It's compact, weighing up to less than ½ the weight of other units. It has adjustable suppression up to 80% of DP range, and adjustable span. A non-bleed relay minimizes air consumption. It doesn't shift zero on overrange. It's unaffected by normal piping stress. In every respect, the Barton 273 is the most significant advance in pneumatic transmitters in the past decade. There's a lot more you should know about it—for complete data write

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INSTRUMENT CORPORATION, 580 MONTEREY PASS ROAD, MONTEREY PARK, CALIFORNIA.

DIGS DEEPER: 15'
MORE REACH: 20' 8"
DUMPS HIGHER: 12' 6"
SWINGS A FULL 190°

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BIGGEST BACKHOE

On the Market

Here's more reach, more digging depth, more loading height than any other tractor-mounted backhoe in the business. Pulls up to 4 payloads a minute. Makes bell hole and spot excavation work easier anywhere. Fits all popular make tractors — new and used!

HYDAWAY-HYDRAULICS
Cylinders, rams, and hoses are tucked away, shielded from dirt and hard knocks of close-quarter work.

NON-SKID STABILIZERS
Independently controlled telescoping stabilizers provide firm footing, level machine on uneven terrain.

3-POSITION DIG-ALL BUCKET
Handles all excavating jobs easily . . . including straight down spot digging. Sizes from 16" to 36" widths.

Send for bulletin today!

PARSONS CO. — A Division of KOEHRING Company
NEWTON, IOWA

Please send new booklet on your 1500 backhoe. 5103—GAS

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Dept. .....
Street .....
City ..... State .....

PEOPLE

JOHN W. FLEER is now comptroller and treasurer of Minneapolis Gas Co. succeeding HUGH H. HITE. Hite was commended by the board of directors for his 20 years' service with the company and 35 years in the utility business. TERRENCE P. O'BRIEN was elected assistant treasurer.

ARTHUR C. MACLEOD with Union Carbide Corp. since 1952, has joined the chemicals division as special assistant to the manager, business planning and analysis department.

Newly elected vice presidents of Louisiana Gas Service Co. are CHARLES J. PUCKETT, RICHARD MELANCON, and AUGUSTUS W. DURNING, all of whom have held executive positions with the company since its formation.

J. B. HANSEN appointed merchandise manager of Empire Stove Company, St. Louis, Mo.

PIERCE R. TOWER, representative for Parker Seal Products, Culver City, Calif.

GEORGE B. TUGGLE, operations vice president for Honolulu Gas Co., is a new director of the LPGA. Tuggle will represent Hawaii's members in the association for a two-year term.

Elected to the board of directors, Pennsalt Chemicals Corp., is GERALD W. BLAKELEY, JR., president of Cabot, Cabot & Forbes Co., Philadelphia.

LAMAR KELLEY recently joined the management consulting division of Ebasco Services Inc. as director of personnel management services, New York.

WARREN HEATH, under supervision of J. E. FENDRICK, manager of the San Francisco warehouse of Dresser Industries, Inc., will manage the new operation in Los Angeles. ED BOSTON and DONALD ESINHART will continue to call on customers.

New post for WILLIAM F. HARRIS is product reliability service manager for the Wilcolator Co., Elizabeth, N. J.

John Fleer
Minneapolis

T. P. O'Brien
Minneapolis

VINCENT T. MILES ended his long career of 35 years in the utility field when he resigned recently from LILCO. Miles began with LILCO in 1926 as an accountant and resigned as treasurer.

J. L. PETERS appointed superintendent of Philadelphia (Pa.) Electric's stores division.

Peoples Gas System, North Miami, Fla., elected WILLIAM M. HUNT, of Putnam Management Co. and trustee of Putnam Growth Fund, to Peoples' Board of Directors. Hunt resides in Boston.

Northern Indiana Public Service Co., Hammond, Ind., announces three promotions: HARLEY W. JENSON to manager of the utility's Fort Wayne division; EUGENE M. SHORB to manager of company's Michigan City district; and JACK W. STINE, administrative assistant to NIPSCO's first vice president.

HENRY L. BECHARD is now director of engineering for the systems division of Information Systems, Inc., Los Angeles, Calif.

New appointments of J. I. Case Co., Racine, Wis., are D. A. MILLIGAN, general manager, marketing and product development; J. P. CODY, general sales manager of industrial division; R. P. MEYERS. industrial eastern division manager succeeding D. H. MITCHELL, who resigned; J. R. HALEY replaced Meyers as north central regional manager.

WILLIAM T. MCLAUGHLIN is assistant general manager of Protective Coatings Division of Pittsburgh (Pa.) Chemical Co.

H. L. Bechard
Information Systems

D. A. Milligan
J. I. Case Co.

J. P. Cody
J. I. Case Co.

B. L. Dawson
Gas Center

C. A. Heath
Heath Survey

JOHN R. FEEHAN is local manager for Garden Grove, Huntington Beach, and adjacent areas of Orange County, with ARTHUR R. BERMUDEZ succeeding Feehan as new business supervisor in sales department of Southern Counties Gas Co.'s San Gabriel Valley division.

LAWRENCE WILKINSON elected director of ACF Industries, Inc. He is executive vice president of Continental Can Co.

RALPH H. NEUBERGER is now production manager for Quindar Electronics Inc., Bloomfield, N. J.

R. S. GATES resigned as executive vice president and director of Collins Radio Co., Cedar Rapids.

JOHN R. HARKNESS is vice president-marketing for Librascope division, General Precision, Inc., Glendale, Calif.

Pacific Gas & Electric Co., San Francisco, announced three executive appointments: O. R. DOERR, elevated to vice president and assistant to PG&E's general manager, S. L. SIBLEY; R. W. JOYCE elected vice president in charge of commercial operations, and W. D. HOWELL appointed general sales manager.

EDGAR A. GAUDETTE appointed vice president and treasurer of Neptune Meter Co., New York.

B. L. (BILL) DAWSON now manager of the Gas Appliance Center, Dallas.

CHARLES A. HEATH elected vice president of Heath Survey Consultants, Inc., Richmond, Mich.

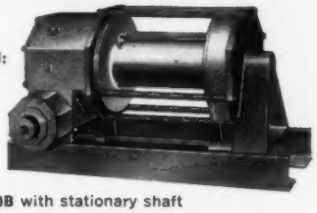
Koenig INTRODUCES A REVOLUTIONARY NEW TYPE OF HEAVY-DUTY POWER WINCH

FEATURING TORQUE TRANSMISSION DIRECT FROM GEAR SPIDER TO DRUM . . . NO KEYS TO SHEAR

20,000 pounds safe hoisting capacity

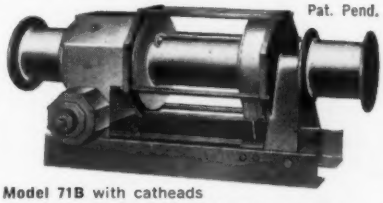
Outstanding features of the NEW KOENIG WINCH:

★ Drum torque load is NOT transmitted by drum shaft . . . no keys to shear . . . torque is transmitted direct from gear spider to drum by means of multiple-splined collar in gear housing.
★ Entire unit, including safety brake, is lubricated by the oil-bath principle, with a generous supply of oil to prevent overheating.
★ Engineered to use standard lubricants available throughout the world.
★ Multiple-plate automatic safety brake, running in oil with one-direction clutch, is easily adjusted or released.
★ Accurate drum clutch position indicator.
★ Gear ratio — 38:1.
★ Nickel-bronze alloy worm gear. Hardened and ground worm mounted on Timken roller bearings.



Model 70B with stationary shaft

Pat. Pend.



Model 71B with catheads

THIS ADVANCED-DESIGN KOENIG WINCH IS RECOMMENDED FOR OIL-FIELD EQUIPMENT, PUBLIC UTILITIES, HEAVY WRECKERS, CONSTRUCTION, AND OTHER HEAVY-DUTY JOBS.

Koenig winches have served the industry with dependable pull and hoisting power since 1934. Koenig also builds a complete line of utility and service bodies.

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ANDERSON TUBING PULLER

— pulls flexible tubing through pipe or bores

Expansion gripper instantly takes hold inside the tubing; the stronger the pull, the tighter the hold; inward thrust permits immediate withdrawal. Tubing is never damaged. Peening, brazing and cutting are eliminated, saving time. Sizes for tubing from ½ to 1½.

FREE LITERATURE

ANDERSON & GRUNSKY

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Manufacturers of time-saving Anderson Test Plugs and Pipe and Tubing Pullers

How these gauges guard your demand metered services

Many gas utilities have established penalty rates for gas used during peak periods. Accurate records are needed to prove these demands—also to show areas where excessive usage is causing pressure deficiencies.

The two Rockwell gauges pictured below provide inked records which verify use and furnish both volume and pressure data. For additional information write: Rockwell Manufacturing Company, Dept. 60-C, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Co. of Canada, Ltd., Box 420, Guelph, Ont.

ROCKWELL TYPE "T" EMCORECTOR—chart is clock driven. One pen traces an accurate record of pressure against time. A second pen records volume in units of either 1,000 or 10,000 cu ft. Two straight reading indexes are provided—one for actual displaced measurement while the other automatically corrects this to base pressure volume.

ROCKWELL COMBINED RECORD GAUGE. Has clock driven chart on which two pens trace (1) gas usage in units of either 1,000 or 10,000 cu ft and (2) gas pressures. These increments can be calculated, if desired, to correct to base pressure volume.

VOLUME AND PRESSURE GAUGES

another fine product by

ROCKWELL

PEOPLE

PHILIP E. CUNNINGHAM is sales development manager for Koehring division of Koehring Co., Milwaukee. DAVID W. MARCHANT president and general manager of Koehring-Waterous Ltd., Brantford, Ontario, to president and general manager, Milwaukee, with KENSAL R. CHANDLER succeeding Marchant in Canada. N. J. DECKER, general works manager and with the company 37 years, has retired.

New appointments by Union Gas Co. of Canada, Ltd., Chatham, Ontario, are: F. R. PALIN, as vice president and continuing as general manager; H. J. DENISON succeeds Palin as treasurer; W. G. STEWART, comptroller, continuing as assistant treasurer; D. E. SMITH named assistant comptroller and an assistant treasurer.

CHARLES E. VANDYKE is employee relations director for Central Illinois Light Co., Decatur, Ill.

H. C. WYLAND elected vice president of Commonwealth Services Inc., New York.

EARL L. ROBINSON joined staff of Great Falls (Mont.) Gas Co. as customer accounting supervisor.

DR. MARTIN A. ELLIOTT is now academic vice president of Illinois Institute of Technology, Chicago. Dr. Elliott succeeds DR. JOSEPH C. BOYCE who is now vice president in charge of graduate studies and research. The successor for Dr. Elliott's current position as director of the Institute of Gas Technology, an IIT affiliate, will be named later.

WELTON R. BAXTER is field and sales representative with Rector Well Equipment Co., Fort Worth, Texas, and will be working out of the Wichita Falls office.

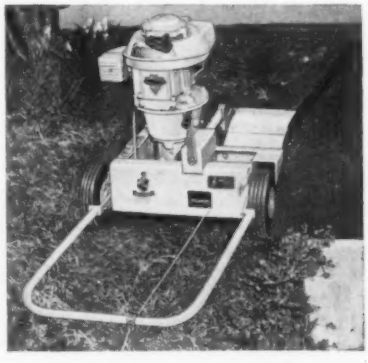
HAROLD SAUERESSIG, formerly of New Mexico Public Service Commission, has joined Rio Grande Gas Co., Brownsville, Texas, assuming duties of vice president.

Deaths

FRANK B. WRIGHT, former vice president of Southern Counties Gas Co., in Cedar Falls, Iowa. Wright retired in March 1960 holding position of vice president in charge of public relations, customers department, and division coordination. He joined the gas company in Pomona in 1912 as a meter reader.

LOUIS A. SCOFIELD who retired June 1 as senior vice president of Consolidated Edison Co., in Bronxville, N. Y. Scofield joined Con Edison as a meter tester in 1912.

WILLIAM WELCH, JR., vice president of Long Island Lighting Co., in Westbury, N. Y. Welch joined LILCO in 1941.



DAVIS PUP DUG 300,000 FT. REDUCED COSTS BY 40%!

Ray Hansen of Washington Terrace, Utah, dug in excess of 300,000 ft. of trench with the Davis Pup. Costs were cut by 40%.

ARKLA Gas Company of Wichita, Kansas, found that six Davis Pups paid for themselves in two months installing gas lights, and subsequently purchased 20 more.

That the Pup is a money maker is proven by thousands of owners. It digs by itself up to 400 feet per hour and handles trenching jobs from 2" to 3" wide, 36" deep to 4" wide, 18" deep. It is fully guaranteed and sells for about $500. Write—**DAVIS MFG. INC., 1508 S. McLean Blvd., Wichita 13, Kans.**

ENGINEER-DISTRIBUTION

Nationally known management consulting organization needs a college graduate with 5-10 years' experience in natural gas distribution, planning, design and operations. Ability to work with electric computers and analyzers is desirable. Some travel required. Include complete resume of education, experience, present compensation and salary requirement in first letter. All applications will be treated confidentially.

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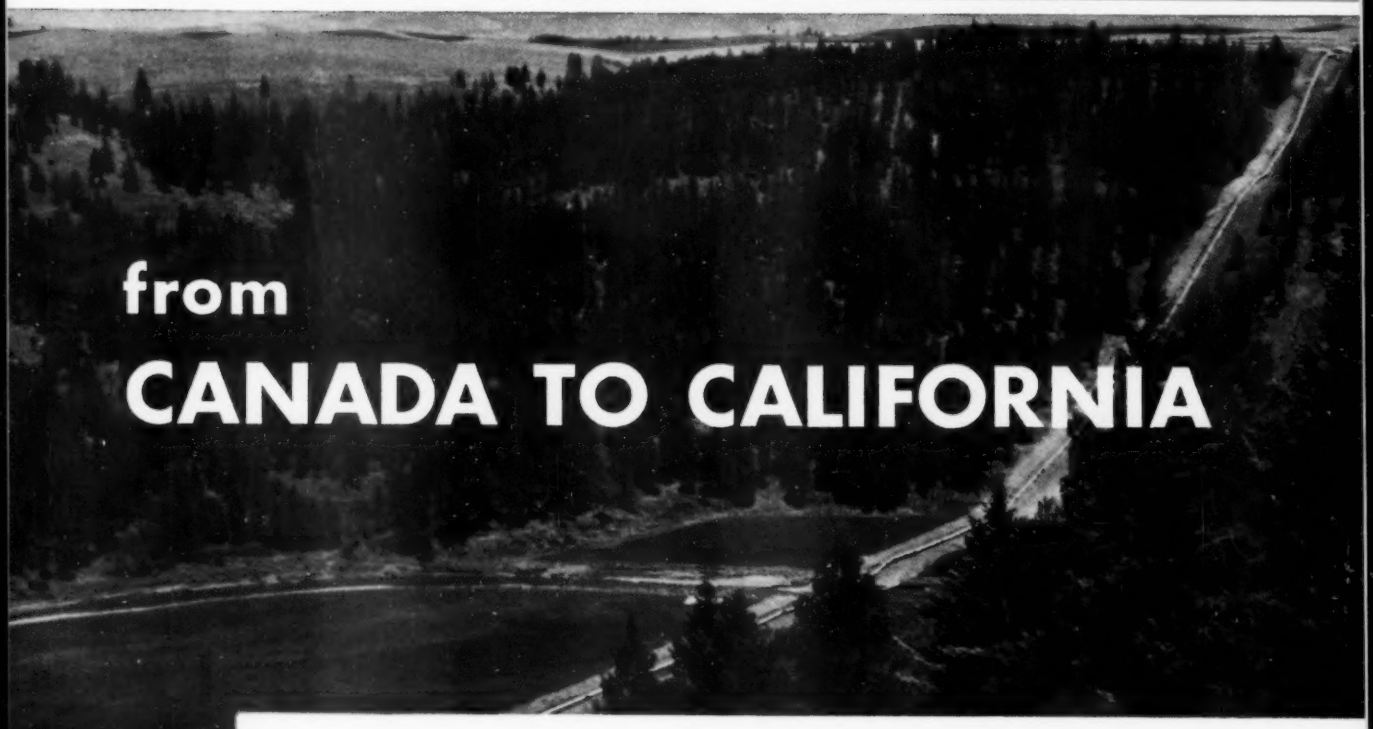
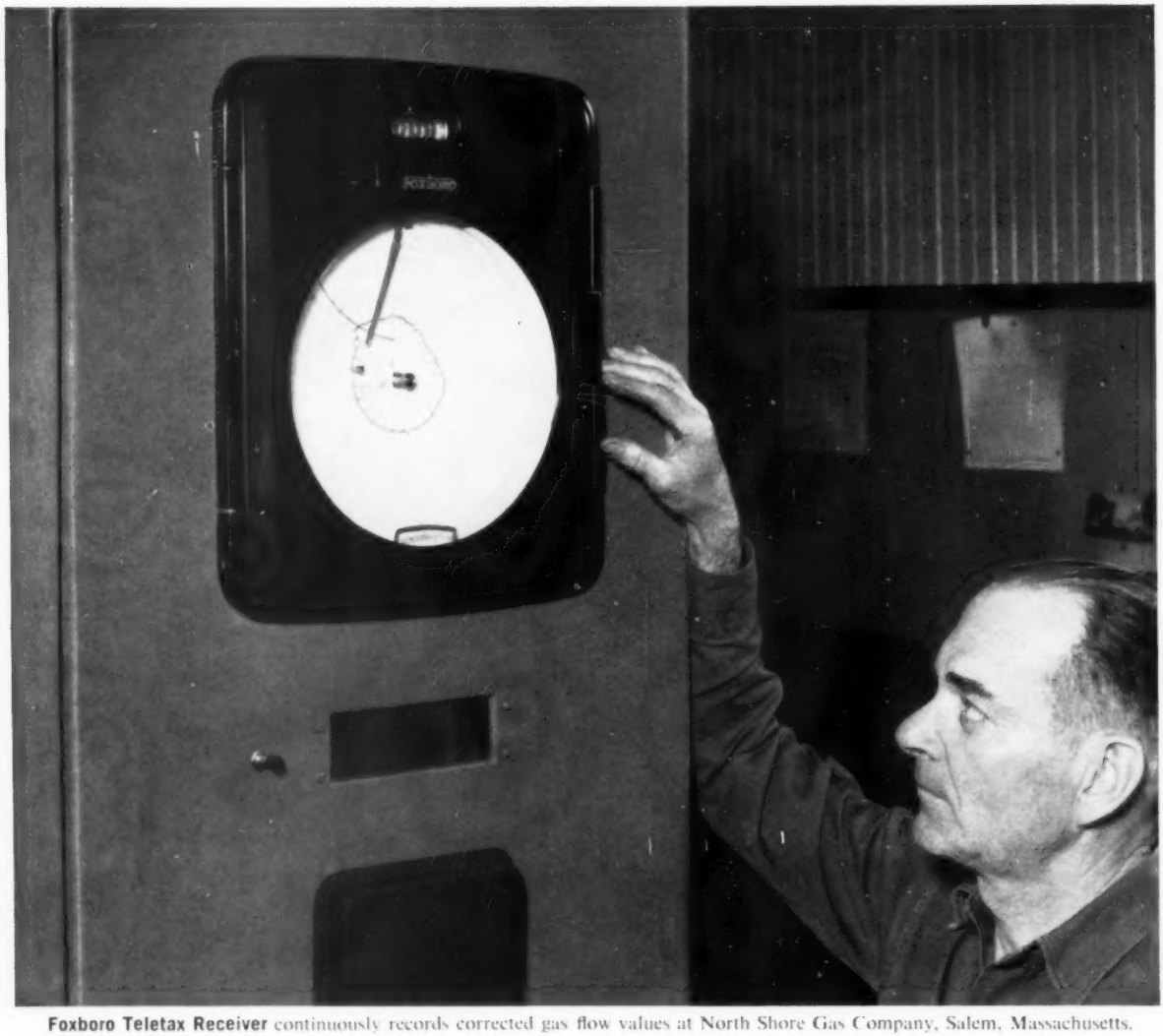
GAS

PIPELINE SECTION



from CANADA TO CALIFORNIA

AS has been suggested, the Alberta-to-San Francisco pipeline will be a large project. Mainline miles will total 1368, with some 1243 miles of it being welded-up of 36-in. diameter pipe. Its route passes through part of Alberta; across a corner of British Columbia; through Idaho, Washington, and Oregon; and down into Northern California to Antioch, near San Francisco. In the doing, it traverses a variety of terrain and a considerable spread in climates. Too, it has its ups and downs.



Foxboro Teletax Receiver continuously records corrected gas flow values at North Shore Gas Company, Salem, Massachusetts.

Foxboro Gas Flow Computer System saves precious time at North Shore Gas Company

Time was when winter peak loads burdened operators at North Shore Gas Company in making time-consuming manual gas flow calculations.

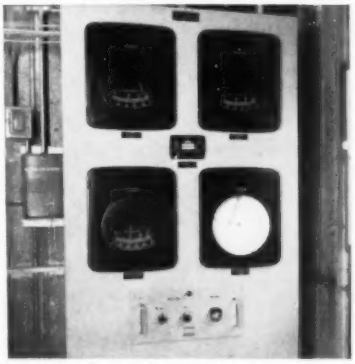
Now a Foxboro Gas Flow Computing System automatically computes total corrected gas flow values right at the company's take station in Gloucester, Massachusetts.

Operators at the company's main office in Salem receive instant results over leased telephone lines — continuously and automatically. They see only the Foxboro Teletax* Receiver. No slide rules, no interpolations, no hand calculations. All the paper work is gone — and so are the mistakes.

Foxboro Gas Flow Computer Systems come packaged and pretested to save you time and money. Ask your local Foxboro Field Engineer about them. Or write for complete details. The Foxboro Company, 358 Norfolk Street, Foxboro, Massachusetts.

*Reg. U. S. Pat. Off.

FOXBORO
REG. U.S. PAT. OFF.



Foxboro Gas Flow Computer makes all computations, including temperature and pressure compensations, at take station in Gloucester, Mass. — transmits corrected flow values to headquarters office.

PIPELINE SECTION

From Canada to California

In Alberta, the design calls for 125 miles of 30-in. and 226 miles of 36-in., to produce a total of 351 miles of mainline in that province. Add to that the 107 miles of 36-in. scheduled for British Columbia, and a Canadian total of 458 miles results.

In the United States, there will be 614 miles of 36-in. built in the states of Idaho, Washington, and Oregon. Another 296 miles of U. S. 36-in. is going underground in California. Together, these figures make 910 miles (all 36-in.) of mainline in this country.

The capacity also tickles the mental conceptuality of the average individual. Pacific Gas Transmission Co. can import into the U. S. a maximum 458.75 MMcfd. The gross take can equal 153.27 billion cu ft in any 12-month period; and can hit 3.826 trillion during the 25-year period of the export license involved.

But that is not all that this fantastic steel piping system will handle. Through a 16-in. lateral (to be owned and operated by Alberta Gas Trunk Line) taking off near Lundbreck, Alberta, and heading southeast, 36MMcfd (max.) will be delivered to Canadian-Montana Pipe Line Co. at Carway, Alberta, some 64 miles away, and re-delivered a few miles farther on, at the U. S. border to the Montana Power Co. This delivery can equal 10.95 billion in a year and 273.75 billion in 25 years.

Then, the Pacific Gas & Electric orientated project will handle up to 152 MMcfd; 51 billion per year; and 1.02 trillion in 20 years that Westcoast Transmission will export to El Paso Natural. This gas will be flowing through part of the subject project in Canada, and will move to various points in Idaho, Washington, and Oregon for delivery to EPNG which will, in turn, deliver to certain local distribution companies.

Boiling it all down to round numbers by stripping out possible max-day takes, compressor fuel, etc., and getting the measurement down to the same pressure base, the deliveries during the initial phase of the pipelines development will look like this:

- 415 MMcfd to PG&E on the California border.
- 140 MMcfd to EPNG at various points between the Canadian and California borders.
- 30 MMcfd to The Montana Power Co. at the Canada-Montana border.

Under full development, the line is designed to ultimately deliver about 800 MMcfd to PG&E and 300 MMcfd to El Paso Natural Gas Co., plus the 36 MMcfd (max.) to Montana Power. But, as the saying goes, this is down the road a piece.

Initial-phase deliveries will be energized by 38,000 hp of compression built into four not-equal (in horsepower) compressor stations. About 225,000 hp will be required on the pipeline downstream from Alberta when full development is reached. An undetermined amount of horsepower will then be needed in Alberta, depending upon the eventual sources of gas and wellhead pressures.

While Pacific Gas & Electric will furnish the basic market for the project, several companies will participate with the Bay Area company in the construction and operations. A look at them is of value. We will start in the gas fields of Canada and, like the pipeline, work down to the market.

ASSOCIATED IN THE ALBERTA-CALIFORNIA PROJECT

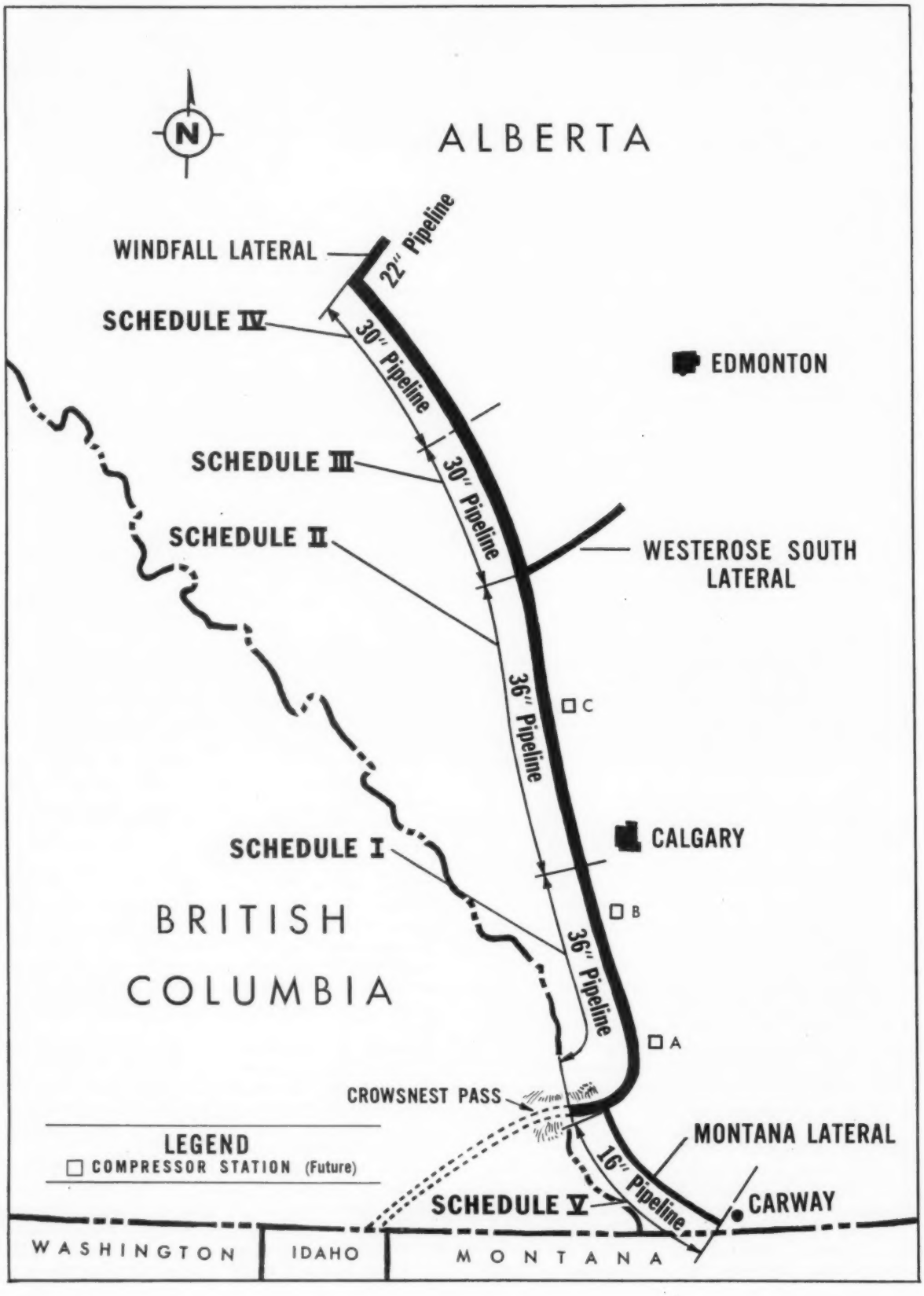
Alberta & Southern Gas Company Ltd.—To find out what part this company plays, we trekked to Calgary, Alberta, which A&S calls home, and chatted with S. Robert Blair, executive assistant to the vice president and manager. As Mr. Blair put it, Alberta & Southern is a group of specialists. Their general specialties are purchasing gas supply and reserves, and securing permits for the project.

It is a wholly owned subsidiary of PG&E, and since its formation in 1957 is often thought of as PG&E-in-Canada—but with a largely Canadian staff. Alberta & Southern does not do any drilling and production. Rather, it purchases gas for the project from others.

Since most of the foothills gas is wet or sour, A&S [usually] takes title at the tailgate of an extraction plant. It holds title of the gas as it flows, or will flow through Alberta and British Columbia. On hitting the Canadian-United States border, the gas is sold by Alberta & Southern to Pacific Gas Transmission Co.—which we will meet in detail further down the pipeline.

Alberta & Southern is also holder of a considerable stack of Canadian permits and licenses. It holds permits from the Oil and Gas Conservation Board of Alberta, issued in the name of the Lieutenant-Governor in Council. These authorize gas to be removed from the Province of Alberta.

To assure adequate natural gas availability for the people of Canada, a National Energy Board Act of Canada requires that permission be obtained from that body to export any natural gas from Canada. Hence, Alberta & Southern sought, gained and holds an export license from the National Energy Board to


N
ALBERTA
WINDFALL LATERAL
22" Pipeline
SCHEDULE IV
30" Pipeline
EDMONTON
SCHEDULE III
30" Pipeline
SCHEDULE II
WESTEROSE SOUTH LATERAL
36" Pipeline
C
CALGARY
SCHEDULE I
B
BRITISH COLUMBIA
36" Pipeline
A
CROWSNEST PASS
MONTANA LATERAL
LEGEND
COMPRESSOR STATION (Future)
16" Pipeline
SCHEDULE V
CARWAY
WASHINGTON
IDAHO
MONTANA

send gas in this project south of the Canadian border. All the gas it buys is so authorized except that going to Canadian-Montana, which holds its own export license from National Energy Board.

So, as a wholly owned gas purchase instrument, Alberta & Southern Gas Co. is constantly searching for, evaluating and purchasing natural gas in Alberta. It constantly keeps its eyes on and stays abreast of all oil and gas activity in Alberta, and in most of the rest of Canada.

Alberta Gas Trunk Line Co. Ltd.—This organization is a very unique—and very friendly and hospitable gas company operating from modern headquarters in Calgary. Further, it was my impression that Trunk Line is a very savvy, know-how company.

Its organization is most unusual. Originally it issued Class "A" common shares with no voting rights, and Class "B" common shares with voting rights. Later, some preferred shares, carrying no voting rights, were issued. The non-voting stock is held by the public. The Class "B" stock (voting) was sold just to Alberta gas utility companies, gas exporting companies, gas producers or processors, and to directors appointed by the Alberta government.

There are five elected directors of Trunk Line and two appointed directors. The gas utilities elect one; the gas exporters (from Alberta) elect one; the gas producers and processors elect three; and the Lieutenant Governor-in-Council appoints two.

Those appointed by the government cannot be from the government or in the public service of Alberta. But, they must be Canadian citizens and reside in Alberta and have been so domiciled for over one year. There are specific provisions that prevent the company from ever falling into even partial control of any company that transports gas from Alberta.

Alberta Gas Trunk Line does not explore for, drill for, nor produce natural gas. Neither does it buy or sell gas. In fact, it never owns gas. Yet it operated 828 miles of pipeline in 1960 and is busily working away on 351 additional miles of 30- and 36-in. pipeline (plus some 22-in. laterals) to be connected with the Canada-to-California system.

It is a pure and simple within-Alberta transporter of gas for others. In addition to moving really substantial volume to the Alberta-Saskatchewan border for the account of Trans-Canada Pipe Lines, it assists existing Alberta utilities by transporting gas to some 33 communities in the province.

Operationally, Alberta Trunk Line has its Plains division which gathers and transports gas for Trans-Canada. This system resembles a huge reclining "Y". One branch of the "Y" extends northwest into central Alberta while the other reaches southwesterly into the Pincher Creek field. Branches come together near Wardlow, Alberta, and the stem goes to the Saskatchewan border where it connects with the across-Canada system of Trans-Canada. Laterals bring in gas along these major arteries. And deliveries are made at a number of points, but in volumes minor in comparison with those to Trans-Canada.

Through contracts signed with Alberta & Southern Gas Co. and Westcoast Transmission, Alberta Gas Trunk will perform a similar transportation function for them within Alberta. Under these agreements, it becomes owner and will be operator of the in-Alberta portion of the big project.

Alberta Trunk Line has activated its second operating unit—the Foothills division—to carry out this work and operate its foothills gas system when completed. Some $85 million (Canadian) is involved with the first stage construction in Foothills division, now well under way. An additional $14-million will be invested in the project next year.

At exactly 1300 ft from the Alberta-British Columbia border, Alberta Trunk Line will turn over physical custody of the gas to Alberta Natural Gas Co.

(I am deeply indebted to, and wish to thank, the fellows with Alberta Trunk Line Gas Company Ltd. for their all-out cooperation and many kindnesses to me on my trip to Canada. They made every effort to show me their project from Windfall to Crowsnest Pass. While I must admit that a Cessna 172 in a storm system over the foothills of the Canadian Rockies is not entirely salubrious to my particular peace of mind, my visit with Trunk Line was a real pleasure. With particular appreciation to John Ballachey, assistant general manager and secretary-treasurer; Eldon V. Hunt, general superintendent of operations; E. D. "Mike" Haverland, pipeline superintendent; and J. W. Knowles, district superintendent, interpid pipeliner (Foothills Div.) and most-relaxed flying companion; I wish to thank all the fellows with this fine company which is doing a great job.)

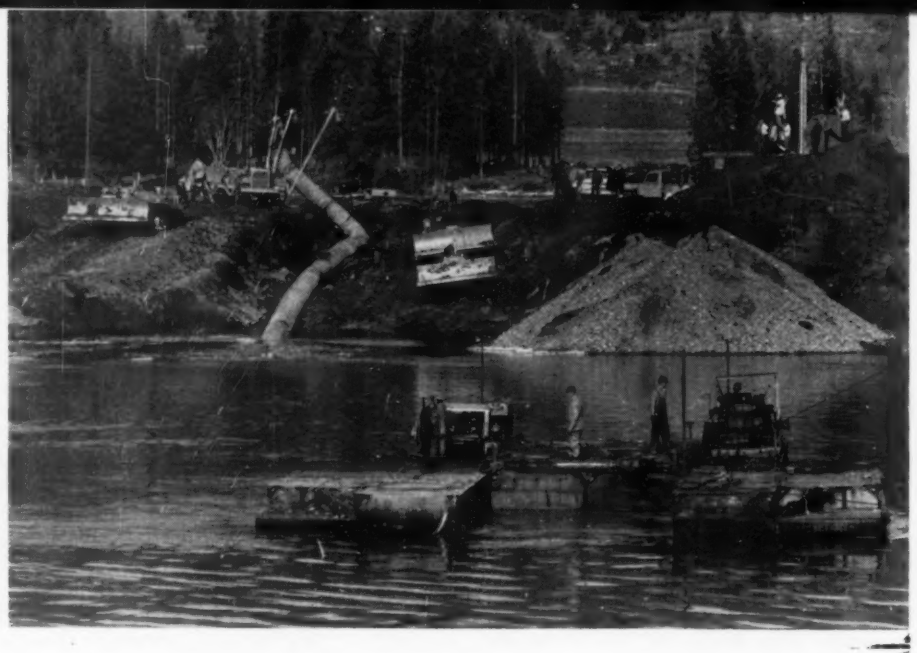
Alberta Natural Gas Co.—This company is another transporter of gas in the project. It too does so for both Alberta & Southern and Westcoast Transmission.

Alberta Natural is owned one-third by Westcoast Transmission, one-third by Pacific Gas Transmission, and one-third by the public. Its system will transport project gas from 1300 ft inside Alberta, through the very glorious southeast corner of British Columbia, to Kingsgate, B.C., where Alberta & Southern will sell to Pacific Gas Transmission. Westcoast will sell gas in B.C. to local distributors and at Kingsgate to El Paso Natural Gas Co., which will distribute its gas to U. S. Northwest. ANG's properties will be 107 miles of 36-in. mainline and the first compressor station (14,000 hp) which will be located just inside British Columbia. A meter station (Kingsgate) and maintenance bases will also be built.

Pacific Gas Transmission Co.—This company will purchase the Alberta-California project gas on the Canadian-United States border for transmission through the states of Idaho, Washington and Oregon. On the Oregon-California border, it will sell the fuel to Pacific Gas & Electric.

PGT will own and operate more of the facilities in the project than any of the associated companies. This will include 614 miles of 36-in. mainline, 26,000 compressor hp to be installed initially, and numerous other facilities. Its equity ownership shapes up as follows:

Pacific Gas & Electric Co.	50.0%
Directors of Bechtel Corp.	6.1%
Blyth & Co., Inc.	7.0%
International Utilities Corp.	7.0%
The Montana Power Co.	2.0%



Moving into the U. S., the 36-in. Canada-to-California pipeline submarines the Kootenai river near Bonners Ferry, Idaho. Pipelayer tractors (on north shore) are walking the tail end of the crossing section into the river as floats maintain buoyancy (Sch. 2, PGT).

Canadian Bechtel Ltd.	1.1%
Stockholders and employees (non-director) of Bechtel Corp. and Canadian Bechtel Ltd.	1.8%
The Public	25.0%

PGT will also transport gas for the account of El Paso Natural Gas and deliver it at various points in its system.

Pacific Gas and Electric Co.—PG&E will own and operate all properties of the project within the state of California. It is building away on its 296 miles of 36-in. mainline from the California-Oregon border, where it will purchase from PGT, to Antioch, Calif. From there, the Canadian-produced gas will be distributed through its existing gas system, placed in underground storage, or utilized by its thermal electric generating plants. No compression will be required on the PG&E segment initially.

Bechtel Corp.—This world-wide, well-known construction firm is an important entity in the whole project. In the very early stages, it was engaged to assist in the economic and feasibility studies required prior to securing authorizations, licenses, and certificates from the many regulatory bodies having some jurisdiction over an international project of the scope of this Golden Gate-bound pipeline.

Then, as the project started to unfold in the PG&E offices, it was realized that the San Francisco utility would not have nearly enough engineers and construction specialists to supply the hundreds of such personnel needed while this vast system is under construction. It did have enough gas engineering and construction people for the in-California section of the pipeline, but not the number that would be needed to supervise, engineer, coordinate, and inspect over the entire system.

So, Bechtel Corp. was awarded a contract for engineering-management services. Its affiliate, Canadian Bechtel Ltd., will provide such services in Canada for Alberta Gas Trunk Line, in Alberta, and for Alberta Natural Gas, in British Columbia.

This is a comprehensive job Bechtel is doing from north of California to the Alberta producing fields. It includes project management, engineering, construction supervision, route location, rights-of-way acquisition, and assorted other tasks consistent with the capabilities of this long-experienced firm of construction specialists.

The important engineering-management work Bechtel people are doing makes them an integral part of the design, engineering, and construction phases of the whole project to the north of California. Their's is the direct responsibility. It calls for complete cooperation and coordination with the office forces and field observers of Pacific Gas & Electric, Pacific Gas Transmission, Alberta Natural and Alberta Gas Trunk Line.

Actually, as we saw in the field from Alberta to California, teamwork has been excellent. All of the forces of the several companies concerned have been working together, building together toward on-time completion of the project.

THE ROUTE AND RIGHT-OF-WAY

The maps on pp 108 and 111 give a quick picture of the Canada-to-California pipeline's route. There is likelihood of over-simplification, however, since on the page it is flat, dry, pretty soft, and not subject to extremes from the elements. Such is not the case with the actual project.

The big gas-mover starts near Windfall, Alberta in alternately hilly and swampy muskeg country that is well-timbered. From there it parallels the backbone of the Canadian Rockies while working out into open range land and past Calgary.

Just before reaching the U. S. border the pipeline takes a westerly set. This carries it into and over the foothills and into the Rockies. It crosses the Continental Divide via Crowsnest Pass on the Alberta-British Columbia boundary. The Rockies are bested in the next 107 miles passage through British Columbia, in which the maximum elevation of 7000 ft is encountered.

Vancouver
BRITISH COLUMBIA
SCHEDULE 1
1
CRANBROOK
WASHINGTON
Seattle
4
SANDPOINT
SCHEDULE 2
Spokane
SNAKE RIVER
SCHEDULE 3
COLUMBIA RIVER
Portland
8
COAST RANGE
CASCADE RANGE
SCHEDULE 4
Bend
IDAHO
SCHEDULE 5
13
GREAT SANDY DESERT
Boise
CALIFORNIA
OREGON
NEVADA
Redding
BURNEY
SCHEDULE 6
NEVADA
Reno
Sacramento
SIERRA
Oakland
San Francisco
LEGEND
COMPRESSOR STATION
COMPRESSOR STATION (Future)

At Kingsgate, the project hits U. S. soil and follows the Moyie River valley into Idaho. By then the Moyie river has already been crossed three times in Canada, but it makes eight more crossings of it in as many miles in Idaho. The Kootanay river has also been crossed in Canada, but after the Moyie, it too must be crossed again (though spelled Kootenai in the U. S.) at Bonner's Ferry, Idaho.

Then it's through rolling farmland and timber as the pipeline goes down, and slowly across the Idaho panhandle to Sandpoint. There, a crossing is made of the 2500-ft wide, 70-ft deep Pend Oreille river.

Leaving that behind, the route enters Washington in the Spokane Valley. It crosses the Spokane river, passes near that city, and is on its way across the southeast corner of Washington through rolling wheat-growing country of that state and Oregon. Not all is peaches-and-cream, though, as there are long stretches of volcanic-origin rock interspersed to keep the rock gangs on the spreads awake.

In the wheat country of southern Washington, sand starts to be a problem and becomes pretty acute in places. The sneaky Snake river is submarined near Pasco, Wash. and right at the Washington-Oregon line some sand as one would expect in the Sahara desert is traversed. Also, in this stretch the 36-in. pipe has to take a 600-ft dip into Juniper canyon (just inside Oregon) with its south wall having a more-than 80 per cent grade, and its north wall being less steep but enough to brag about.

Before long the pipeline hops off a plateau into Oregon's John Day canyon and following tributary creek beds for some 10 miles to effect the crossing. It's beautiful country, but far from ideal pipelining. Then getting ready to approach Bend, Ore. the route hits rock and lots of it.

South of Bend the line runs through timber and pumice until it again hits serious rock in southern Oregon. On into California, for over 100 miles, the pipeliners had to fight vast lava beds. And the Cascade mountains had to be traversed in this stretch too. Lake Britton made some sport with construction activities before the route works out of the Cascades and into the Central Valley floor to pass between the Coast and Sierra Nevada ranges. It follows the western side of the valley to avoid the more highly cultivated areas. The Sacramento and San Joaquin rivers have to be crossed before the project terminates at PG&E's Antioch meter station.

While a variety of climates and temperatures are to be expected, it is estimated that pipeline temperature will not fall below 25 deg. F. The spread in ambient temperatures expected to be experienced ranges between a minimum of –50 deg. F in Alberta and perhaps 117 deg. F in Oregon and California.

Pacific Gas & Electric employed radar-type surveying instrumentation for its 296-mile section in California. This was very successful as it produced greater speed than line-of-sight techniques, and equal or better accuracy. It also permitted continuation of work in snow, rain and fog.

Determination of route and right-of-way for the remainder of the line was a task for Bechtel's people —with assists from PG&E and PGT. This involved a combination of covering the entire route on foot, mapping, and aerial photography. First, a proposed route was sketched from available maps by the engineers. This, with some alternate routes, was laid out on maps and aerial photos. Pipeline locaters then took to the field in teams of two or more and actually hiked over the entire out-of-California route.

Locaters defined exact route and plotted detail on aerial photographs from which enlarged alignment sheets were produced—one for approximately every five miles.

In August of 1959, Bechtel forces started negotiating right-of-way for the pipeline from the California border north. PG&E's own ROW department did this in California.

In general, a 100-ft wide ROW was obtained. It was felt this was needed for handling the big, heavy pipe and to provide for future looping. This width has proven very satisfactory under actual construction conditions.

Since both PG&E and PGT had decided against pipeline contracts carrying clauses providing for premium payment for hard-rock work, a survey of the route (to the Canadian line) was made so that contractors could be as accurately informed as possible on its incidence. Both Bechtel and PG&E teams made this investigation.

Most of the rock surveying was done by a two-man party using a gasoline-engine portable drill, mounted on a Dodge Power-Wagon. Seven-eighths-inch cores were taken at approximately 2000-ft intervals or where sharp changes in terrain occurred. Data have correlated very well with trenching experience to date.

In addition to finding the shortest, easiest, and cheapest route for the pipeline, route makers had to consider accessibility under various weather conditions expected. Also, the ROW acquisition people had to obtain compressor station sites for initially-to-be-built stations as well as for those planned into the pipeline under full expansion. And sites had to be obtained — on mountain peaks or other high ground—for the project's microwave radio system that is being constructed from Calgary, to Spokane, to San Francisco.

GENERAL DESIGN OF THE PIPELINE

The Alberta-to-San Francisco project will be fabricated and implaced to equal or better the American Standard Code for Gas Transmission and Distribution Piping Systems, ASA B-31.1-1958, and additional requirements of regulatory commissions where applicable. Of particular interest is the applicability (in California) of the California PUC's General Order No. 112 which became effective on July 1, 1961.

Like all pipelines, this one requires steel and a lot of it. They tell us up at PG&E that the project has requirement for 16,800 railroad carloads of pipe. That 36-in. stuff is transported eleven 40-ft joints per gondola. For statistics lovers: that's about 184,800 joints of pipe; which represent about a half-million tons of steel; and if placed end-to-end, would reach from deep in Alberta, Canada to San Francisco, Calif.

Naturally, those 184,800 joints of yard-wide pipe are being placed and welded, end-to-end right now,

and, if the engineers were not using warped slide rules, will indeed connect the two areas mentioned.

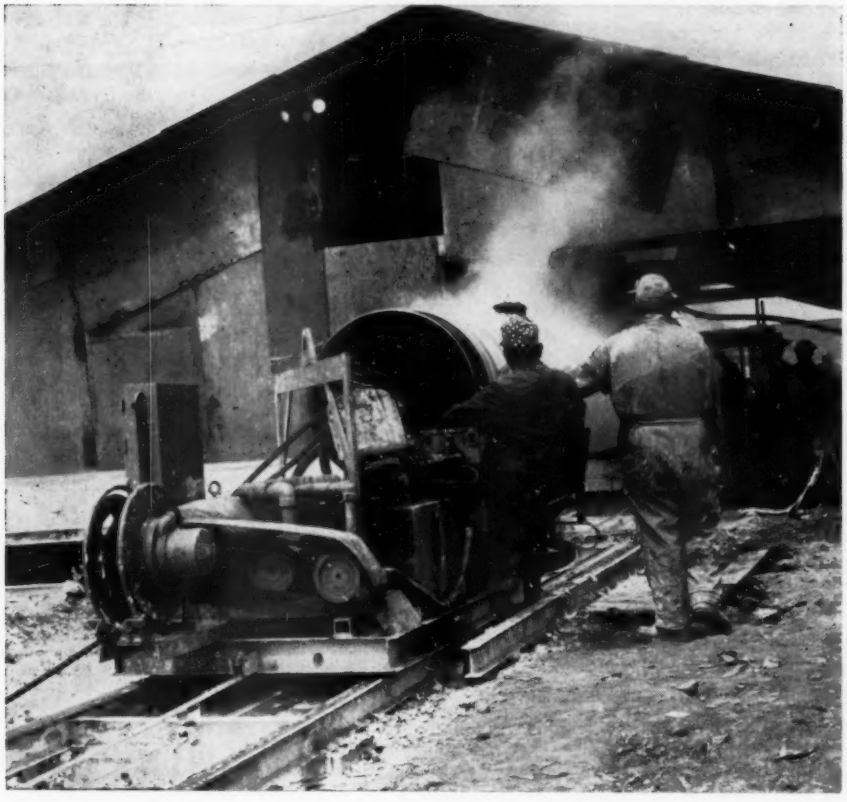
To gain increased spread production, about half of these welds in the pipeline are being made in field double-jointing yards. Automatic welding machines in double-jointing yards produce 80-ft joints that are strung and used for normal right-of-way spread work. Pipe used in some extremely rough terrain and for special purposes was not double jointed.

While this technique of pipeline building is not new, with by far the majority of all pipe in over 1300-mile length being double-jointed, the Pacific Gas & Electric project is the longest and largest pipe line for which double ending has been used as the standard procedure.

Pipe

The basic pipe in the project is manufactured in compliance with the American Petroleum Institute Specification for High-Test Line Pipe. It is 36-in. outside diameter, 0.438-in. wall thickness pipe, with a minimum yield strength of 52,000 psi. In terms of the trade, it is API 5LX-52, and in the basic wall thickness weighs 166.17 lb/ft.

The 0.438-in. wall material is used for Class I (ASA B31.1) construction locations. Heavier walls—up to 0.750-in.—are used in other construction classifications and for specific purposes. For example, 36" diameter pipe for river crossings is 0.531-in. WT, and the wall for discharge piping and mainline runs immediately downstream from compressor stations is heavied to 0.656-in.



ABOVE: Example of perfect trenching down the line near Waitsburg, Wash. This is pretty typical of rolling farm land encountered, for stretches, in Oregon and Washington. Dust was the big problem here (Sch. 3, PGT). LEFT: Field yards at railheads were used extensively on this project for double-jointing and coating operations. This one, near Winona, Wash., shows yard mechanization as a power-dolly handles an 80-ft, internally coated joint coming out of an external coating and wrapping machine (PGT section).

Properties of the basic pipe will permit a maximum operating pressure of 911 psig at the discharge of compressor stations. Classification pipe, pressure limiting stations, and relief valves will permit any section of the line to be shut in against this pressure without exceeding the design working pressure. The entire project will be proof-tested, prior to initial operation, to a minimum of 81 per cent of the specific minimum yield strength of the pipe material at even the highest elevations in the project. Maximum test pressure for 0.438-in. wall pipe will be about 1260 psig, which will produce a hoop stress equal to the specified minimum yield strength of the pipe.

Testing

All testing will be done hydrostatically. This is the longest project ever proofed by this method. Just the hydrostatic testing alone is a comprehensive and interesting operation. For example a water test to 81 per cent of yield in the segment of pipeline crossing over Moyie Mountain in B.C., where a max-altitude of 6600 ft is encountered, will call for considerable pumping. Also, it will require numerous cuts in the pipe.

Protective Coatings

Protective coating systems specified for the pipe are also yard applied from the Alberta-B.C. line south. Field application is used on the Alberta Trunk Line segment.

Trunk Line specified an external protective system of a primer, asphalt-based enamel, and fiberglass inner and felt outer wraps. Application is with conventional line-traveling equipment.

Alberta Natural's and Pacific Gas Transmission's segments are externally coated at the double-jointing yards with a single-wrap, consisting of primer, asphalt-based enamel, unsaturated glass mat inner wrap, and a 15-lb, asphalt impregnated felt is used for outer wrapping. The system totals about 3/16-in. in thickness. The external coating process is completed with application of a whitewash spray. Field joints are flood coated in the conventional manner.

While the single-wrap predominates between the Alberta and California borders, known corrosion "hot-spots" are mitigated by application of two coats of enamel, a saturated glass wrap, and felt on the outside.

A number of the major river crossings—for example the Kootenay and Kootenai, Pend Oreille, Snake, Sacramento, and San Joaquin—and some of the lesser ones, were or will be Somastic coated and given about 6 in. of reinforced Gunite for mechanical coating strength and to provide at least the 10 per cent negative buoyancy required.

Pacific Gas & Electric's in-California section of the project will be Somastic coated for its entire 296 miles. The contractor, H. C. Price Co. (Bartlesville), elected to go Somastic and offered a bid that compared very favorably with the more conventional enamel coating system; hence, a $\frac{5}{8}$-in. thick Somastic application was selected. This too is yard applied. For field joints, Price uses a mobile Somastic plant that moves along the ROW. A tractor-handled, hydraulic-powered field mold gives the Somastic over the field welds a 2000 psi compacting squeeze.

Internal Coating

Of great interest to the entire gas industry is the extensive application of internal coating for the project. Approximately 947 miles of the 36-in. mainline, from the Alberta-B.C. boundary to about 70 miles north of Antioch, is being internally coated with 2.5 to 5 mil of epoxy resin. This material is being furnished by Napko Corp. and Copon Associates (Houston), and R. F. Walsh Co. Ltd. Internal coating is being done at the double-jointing and coating yards as well as in the pipe mills.

Pacific Gas & Electric, and Pacific Gas Transmission designers feel that improved flow efficiency will be experienced with the internal coating. PG&E's experience with its 34-in. Super-Inch system indicated that selection of a friction factor of 0.00230 would be valid for the 36-in. pipeline, when used in the modified-Weymouth formula, corrected for elevation. Studies indicate that with internal coating, the friction factor could be reduced to 0.00205 under the full development 1100 MMcfd delivery flow rate.

The estimated cost of the internal coating in place approximates $1.5 million. However, if the friction factor reduction is experienced, some 28,000 hp of compression will be saved. This reflects a capital savings of around $7 million.

Other advantages are expected from internally coating. It is logical to expect less corrosion to the internal surface during storage and transit operations involved with putting the pipe at trench edge. It should result in a substantially more efficient and economic internal clean-up after construction, which would result in less foreign matter, and water from hydrostatic testing, remaining in the conduit; hence, cleaner gas to consumers. Too, application operations of the internal coating have turned up some internal pipe defects which might otherwise have been built into the pipeline undetected.

The designers realize there is risk involved since experience with internal application of epoxy resins extends back only five or six years in the gas transmission business. But, since a coating in-place operation after completion of construction did not appear practicable, PG&E and PGT decided to take the risk during the initial construction phase rather than absolutely eliminate advantages to be reasonably expected from internal coating. Special pressure connections are being installed to permit precise friction factor determinations after the line goes into operation.

Valving

Full-opening, through-conduit valves have been selected for mainline block-valve assemblies throughout the project.

One innovation in block-valve assemblies is taking the 16-in. blow-down stack some 100 ft away from the valve itself. This eliminates some distress to personnel operating a block when testing or blowing down elevated pressures. And, as both sides of the pipeline are connected to the blowdown, a bypass is provided to permit operation of the 36-in. valves under maximum differentials.

Special ball end-screw gearing is used on all of the large valves to reduce friction and consequently the

force required for either manual or power operation.

Also, a manufacturer (E-I-M) made, at PG&E's request, some 12-24 volt motors designed to power operate the normally manually operated values. These motors are energized from an automotive vehicle's electrical system; hence, a pipeliner going to the field to operate one of the big valves can have a portable power-actuator with him.

Scraper Tubes

Pipeline-pig launchers and receivers are being installed at all present and future compressor station sites from the mainline's point of origin down to the Washington-Oregon border. Thirty-six-inch Grove Seal-O-Ring gate valves and Rockwell Hypresphere plug valves are being used on the main pipeline. Sixteen-inch Rockwell Hyperseal plug valves were selected for the blowdowns. Valves supplied by the foregoing manufacturers, as well as Walworth, are being used in the stations.

Thus, with the valving and equipment designed into the pipeline, on-stream pigging will be practical from Alberta to Oregon. The designers concluded that if the upper portion of the terrific-tube is well cleaned and maintained in that condition, efficiency of the southern portion will not suffer and no pigging will be required for it. PG&E's ten-years of experience with its 34-in. pipelines from Topock to Milpitas has shown no deterioration in efficiency, and influenced the decision.

Compressor Stations

Four compressor stations will power the pipeline on completion of its initial construction. As the project goes into operation, there will be no compression on the in-Alberta segment. However, three stations in that segment are contemplated for the future.

The first compressor facility on the line as-built this year will be in Alberta Natural Gas territory, just inside the B. C. line. It will be Station No. 1 and is located in pretty high country on the western approach of Crowsnest Pass. Four 3400-hp, Ingersoll-Rand, KVH-12, four-cycle, natural gas fueled, reciprocating integral engine-compressor units will soon be chugging away there in some mighty pretty scenery. They will, however, be a bit lonely as communities up that way are not too plentiful.

The next compression will be at Station No. 4. This one is spotted about 150 miles downstream near Sandpoint in the Idaho panhandle. Prime mover there will be a Westinghouse 6000-hp, two-shaft, regenerative combustion gas turbine. This machine will drive a Cooper-Bessemer centrifugal compressor.

Toward California by about 208 miles (from Station No. 4) will be Station No. 8. This one's prime movers will be two Cooper-Bessemer LSV-16 four-cycle engines driving a Cooper-Bessemer centrifugal compressor through a Western speed-increaser gear-train. These 10,000 "horses" will be located very near the Washington-Oregon border.

Station No. 13, another 10,000-hp engine-driven-centrifugal facility, is located another 278 miles or so closer to the pipeline's terminus. It sits kinda' out by itself about half way (as the gas goes) between Bend and Klamath Falls, both in Oregon. The engines selected are two Clark Bros. TPV-12's. These are each 5000-hp, two-cycle gas engines. Their mechanical power will be transmitted through Falk speed-increases to Clark centrifugal compressors.

Pacific Gas & Electric will have no compressor horsepower in its segment at this time. There will be two stations, Nos. 15 and 16, in California when the line is fully powered. At that time, about 225,000 hp of compression will be required downstream of the British Columbia-Alberta border, and an undetermined amount in Alberta.

Remote Control System

Compressor stations are designed for remote, unattended control and operation. Station No. 1, while not to be remotely controlled or unattended during the initial period of the project's operation, does have design provision for such operation in the future and as-built will utilize rather sophisticated local control and supervision.

As initially built, the Pacific Gas Transmission segment of the project will not be the most advanced instrumentation job in the gas pipeline industry. Transwestern, Colorado Interstate, Columbia Gulf, etc., are equally advanced. However, the approach taken by design engineers in the PG&E-PGT-Bechtel team may very well be the most advanced. The thinking that went into the present design of the remote control instrumentation in the form of preparations for advances in the field of general automation to come, is particularly noteworthy.

The supervisory equipment manufacturing company —the SIE Division of Dresser Electronics (Houston) —was handed, along with a contract for the equipment, prime system responsibility as part of the work. The control system selected utilizes solid-state equipment. SIE will be given assistance by PG&E, et al, and will utilize Texas Research Associates (Austin). Such an assignment to Dresser/SIE shows the growing trend toward cooperation between gas pipeline companies and electronics systems suppliers in developing systems particularly suited for gas transmission purposes.

The PGT over-all control philosophy stipulates provision of as much local control at each compressor station or other facility as practical. Coordination of stations is then accomplished by telemetering a minimum of data to and from the central control-dispatching facility.

Nerve center of the remote control system will be from PGT's Spokane Dispatch Center. This will be housed in a new, modern building to be constructed there, and in which PGT operating headquarters will be maintained. Key operating data from compressor and flow control (metering) stations will be brought into the center via a PGT-owned microwave system. Dispatchers will have digital or visual indication of the operating data, alarms, status indicators, etc., from each remotely controlled station. Such intelligence will be displayed by presentations of an electric typewriter (which will log the whole system hourly), digital visual-display panels, and status/alarm lights arranged for maximum dispatcher

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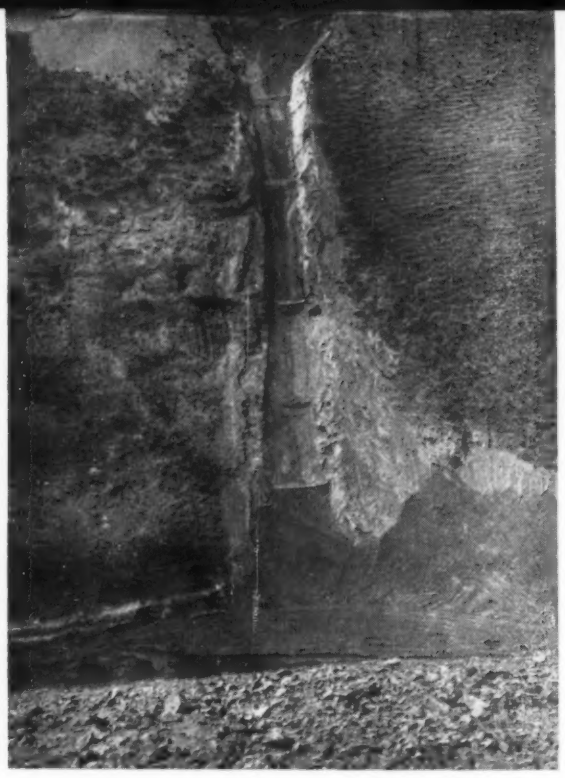


ABOVE: The pipeline, with California still on its mind, goes down in Juniper canyon, practically on the Washington-Oregon line, and climbs up the almost vertical wall on the other side. The across-canyon wall is about 600 ft from canyon floor to plateau. Sack breakers, at approximate 100-ft intervals, have been installed to hold the cover, which was hand backfilled (Sch. 3, PGT). BELOW: To prove this pipeline goes through a little bit of everything, here's a shot of sandy desert just downstream from the Oregon-Washington border. Pipeline is installed and ROW has been strawed to prevent sand cover from eroding (Sch. 3, PGT).

utility and convenience.

The control parameter for all stations will be station discharge pressure. At Station No. 1, the set-point will be specified by the dispatcher in Spokane, but will be manually set in a station controller by a station attendant. The local station controller will then control and monitor the four engine panels (one for each engine-compressor unit), the outputs from which will control pre-lubrication, starting air, ignition, fuel gas, and flowing gas valves for each compressor unit. The station controller will also sequence the station valves.

The station controller will vary individual engine speed and select the optimum number of compressors needed on line to maintain the set-point condition. A secondary control will change pocket clearances to keep engine loads at or near rated torque over the expected ranges of flow and pressure. Changes in this variable are provided only at periodic intervals to preclude interaction with the primary control loop.

When more than one reciprocator is in on-line operation, small and discrete offsets will pre-set in each governor signal to eliminate resonant-speed effects. Station Nos. 8 and 13, having reciprocating engine-driven centrifugal compressor machinery installed, will be controlled similarly. The big difference will be that they are designed for unattended operation and the station set-point (again, discharge pressure) will be remotely set from the Spokane Dispatch Center. The operations will be monitored from the center. There will be no requirement for the pocket clearance control system. However, comparable controls for centrifugal compressors will be provided.

Station No. 4 with a turbine-driven centrifugal unit, will also have set-point adjustment strictly remote from Spokane. However, a completely different type of controller will be used with this prime mover to vary its speed. The turbine controls are being supplied by Westinghouse with the turbine.

Ultimate capacity of the remote control system is designed to accommodate up to 98 remote installations; each with up to 14 data points, 14 control points, and 44 status alarm points, or any equivalent combination of this total.

The supervisory equipment at the Spokane control center will continuously scan all remote points. About one minute is required for up-dating all data, status indicators, alarms, and other information from any remote installation.

Physical construction of the supervisory system components is unique. Virtually no electronic knowledge is required for pipeline operating personnel to adequately maintain and keep the system in operation. Modular functional blocks are built on standardized plug-in boards. These phenolic boards use etched (not printed) circuits. Standard maintenance includes use of a built-in marginal test circuit. Here, two primary operating voltages are lowered so that any marginal operation is immediately apparent. In addition, a standard universal test instrument is supplied.

SIE will provide comprehensive training for operators and maintenance personnel as part of the sys-

tem. Involved are orientation, working-laboratory exposure, and service routines for the equipment.

Communications Systems

The Alberta-to-California pipeline system will be augmented by a microwave radio system being constructed. It will provide audio communications, TWX and data transmission, and will continuously link San Francisco, Spokane, and Calgary, and key points between. Further, PG&E and PGT will expand radio communications with an extensive VHF net between the Canadian border and the Bay city. Base repeater stations will pop up on 17 mountain-top sites therebetween prior to the pipeline commencing operation.

Ninety-six PG&E and PGT vehicles will be equipped with mobile transceivers. These are highly transistorized units—MOTRAC, from Motorola, Inc. The elevated repeaters will both extend the radio communications range of the mobile units and link the microwave and VHF systems for communications between mobiles in the field and the various key operating and control points. Also, 11 "Handie-Talkie" portable, personal VHF transceivers; and base stations and custom-designed remote controls panels, for both Spokane and Antioch, are integrated into the VHF system. All VHF equipment will operate in the 40-50 megacycle band.

LOOKING AT THE FIELD WORK

Some might call a field trip over the pipeline real work. Personally, the opportunity to be exposed to the scenic grandeur and vitality of the parts of these two great North American nations this project traverses and links, was very inspiring work—if it can in truth be called work at all.

As has been mentioned, a good part of the field work was done in field plants rather than along the right-of-way and over-the-trench. Probably more of this pipeline was built in field yards than has been any pipeline built to date.

Operations in the field plants included double-jointing; external coating and wrapping; and internal coating. Naturally, inspections of these processes were also done in the yards. In Alberta, double-jointing yards were used, but external coating was applied on the ROW in the conventional way.

The advantages, disadvantages, and economics of both approaches to pipeline construction are subject to discussion. This is not the place to debate them. One can conclude that every company will make a choice in this respect based on its particular conditions, requirements, and resources.

There is little doubt but that a good pipeline can be built by either method. Conversely, you can get a real lousy job by either approach. So, the method is not nearly as important as the manner in which the job is done under a given method.

For their conditions and objectives, ANG-PGT-PG&E felt heavy use of railhead yards for double-jointing and both internal and external coatings reduces pipe handling on the ROW, increases spread production per day, and assures quality of welds and coatings. PG&E has long been an advocate of this type of operation.

Further along towards California, we see a backhoe making trench at the entrance to John Day canyon in Oregon. After the sharp drop into the canyon, the pipeline follows the creek bed for the next 10 miles (Sch. 4, PGT).

The logistics and mobility of the welding-coating yards was most spectacular to me. When briefed on the project in San Francisco, the planning and physical task didn't register when mention was made that a particular jointing-coating yard had worked at one location, then moved to another, and was now in the process of tearing down and setting up in still another location some hundreds of miles away.

But when viewed on the ground, the picture became instantly clear. The logistics and physical work of moving a railhead welding-coating yard is a highly technical job. The same can be said of pipe supply to a yard and to the ROW. Then, the flow of the various materials in huge quantities to the double-jointing and coating yards could also make a study in itself.

For PG&E's California section, H. C. Price Co. Somastic coated and double-jointed a portion. And, Kaiser Steel Corp., fabricator of most of the 36-in. pipe for the California section, also double-jointed at its Napa mill. Price Co. applied the Somastic and L. C. Russell Co., Inc. (Beaumont, Texas) put on the internal epoxy for the Kaiser-produced 80-ft joints near the Napa mill.

In Oregon and Washington, Stanley-Bledsoe Corp. (Tulsa) had five big railhead yards to do double-jointing and both coating operations. These leap-frogged with dispatch, as needed. And, Price Co. operated two for Washington and Idaho.

While the plants operated by the various contractors varied in many details, the basic operations were very similar. They were essentially production-line plants. Pipe first came from car or stockpile to the double-jointing racks. Automatic, submerged-arc welding machines ran external and internal beads and passes.

From the welding racks, pipe moved to internal coating machines where the epoxy resin was semi-

automatically sprayed on. Then, the outside surfaces were cleaned and the particular external coating and wrapping system being used was applied with stationary equipment. Whitewash was next sprayed on and the doubled joints then went to stockpile, ready for stinging.

A high degree of automaticity—for these types of operations, anyway—was used. Pipe was usually rolled between stations and handled with conventional or specialized materials-handling equipment. A minimum of lifting and muscling of pipe at all stages was noted. Certainly there was less hand work and wasted-motion while handling in these mechanized field yards than one sees in some permanent plants.

THE SPREADWORK

Starting where the project's gas does, let's visit along the line.

Schedule IV—Alberta: The project starts at the tailgate of Pan American Petroleum's gas processing plant in the Windfall field of Alberta. From there, 18.4 miles of 22-in. OD pipe takes the gas to the start of Alberta Gas Trunk Line's mainline. This is the Windfall lateral.

The mainline starts where the Windfall lateral is tied in. However, it is 30-in. OD mainline for the first 126.4 miles on the trek to San Francisco.

The Windfall lateral and the first 63.1 miles of 30-in. M/L is Canadian Schedule IV, contracted to Dutton-Williams Bros., Ltd. (Calgary, Alberta).

This schedule is building pipeline in remote and sparsely populated country. The railhead at Edson is a long way from the ROW and roads are mostly among the missing.

This contractor worked hard to get as much done in the winter as possible. As a result, a good bit of clearing and grading was accomplished, and stringing the mainline 30-in. was completed before the spring thaw brought roads' bans (until the frost gets out of the ground) and break-up. Dutton-Williams had hoped to get the stringing done on the Windfall lateral too, but the break-up came earlier than expected.

This is the country of hills, heavy timber, creeks, muskeg, and little access. Pipeliners became road builders up there as it is do-it-yourself country. Miles and miles of roads through muskeg swamps were constructed by the contractor. This involved cutting and rip-rapping logs, then implacing earth fill and gravel on top to form the roadway. The contractor will leave these roads for pipeline operations after completion of construction.

For most of us down here, it would have been cold work. But Canadians consider the winter of 1960-61 up in the Windfall country as pretty mild and dry. Snow was "light."

In May, the spread was able to really get rolling making pipeline. At that time, however, winter's work had already produced: 78 miles cleared and graded; 45 miles of ditch; 63 miles of pipe strung; 30 miles laid; 28 miles backfilled; and a mile cleaned up.

Schedule III—Alberta: Majestic Constructors Limited (Toronto and Edmonton) has the contract to build Schedule III for Alberta Gas Trunk Line. Involved are 63.3 miles of 30-in. mainline and the 38.3-mile, 22-in. Westerose South lateral.

The pipeline on this schedule too is in hard-to-get-to country. In fact, there is just one established road between the schedule's kickoff point and the north fork of the Saskatchewan River—which is just about where the schedule ends. So, Majestic had to get into the road-building business also.

General character of the country is rolling hills, with a lot of muskeg thrown in. This spread made good progress during the winter, got a bit wetted out during break-up, and then went at it again. It completed all of its clearings and grading, plus river crossings, during the winter.

Schedule II — Alberta: Thirty-six inch mainline started with Schedule II some 223.3 miles via pipeline from the Alberta-British Columbia border. This 112.5-mile stretch is being built by Alberta Consolidated Pipeline Builders. This is a pretty vanilla stretch of pipelining country as compared with the others in Canada. However, it too had its problems and seems well on the way to licking them. For example, ditching started April 18 after clearing, grading, and stringing during the winter. On April 19, ditching was shut down due to a snow storm. A restart was made on April 24. However, it was shut down again by another snow storm on April 25. Favorable weather returned late in the month—and so it goes in the wonderful world of spread-work.

As an example of double-jointing yard movements, take the one that was making 80's out of 40's for Schedule II. It started welding at Cadner and finished up there on March 22. It was moved to Jumping Pound and started welding on March 27. Welding at Jumping Pound was completed April 4, and moved to Cremona, where double-jointing was completed in May. Though the external and internal coating machinery was not involved, it's still a lot of movement for a railhead yard.

Schedule I, worked by another Majestic Constructors' spread, starts near Calgary and ends 110.7 miles further along, about 1300 ft from the line marking the separation between the Provinces of Alberta and British Columbia. It is 110.7 miles of 36-in. pipe. On the southern end of the schedule—where the construction spread started pipe work—the pipeline makes its first thrusts through the Canadian Rockies. This is some of the most spectacular terrain on the whole system.

Near Cowley and Lundbreck, the pipeline starts up and goes over the Livingstone range, reaching some 6300 ft of elevation. It then takes a contractor-cut rock ledge around solid-rock Turtle mountain and traverses Crowsnest pass. This is a wild, beautiful country, but was not greeted with a great deal of joy by spreadmen. Boulder fill, glacial till, and solid granite, along with chert, shale, and limestone outcroppings were just some of the things in the way. Steep grades and even some muskeg also seemed purposely placed to thwart the pipeline builders.

In this steep, high country, 40-ft joints were used. These are heavy enough to be handled on the grades involved as 0.500-in. wall was used through this inhospitable (for pipelining), inaccessible country.

Local color is to be had in the Canadian Rockies too. At Lundbreck, near the take-off point of the 16-in. lateral to Carway and The Montana Power Co., I had the experience of encountering the first two-story out-house it has been my privilege to view in many thousands of miles spent wandering around on gas pipelines. Also, on the approach to Crowsnest pass is the rubble of Frank Slide where a whole mountainside of rock slid off Turtle mountain some years ago burying the community of Frank with considerable loss of life.

All things considered, we will say that Alberta Gas Trunk Line, and the contractors in Alberta, have been setting a good pace and standard of pipeline construction for the project. Winter work in Canada was particularly rugged and accomplishments during this season are very creditable. Most of the creeks and minor rivers were crossed during the cold weather. And the tougher crossings such as McLeod in Sch. IV; the North Saskatchewan in Sch. III; the Red Deer in Sch. II; and the Crowsnest River in Sch. I were also put in before the spring thaw brought high water. Albertans are doing a beautiful job in a beautiful, friendly, developing land.

Schedule 1—British Columbia: Alberta Natural Gas' section of pipeline through British Columbia continues the trek through the astonishingly scenic Canadian Rockies. The pipe making the trip is 107 miles of 36-in. and its construction is known as Schedule 1. Contract for the B.C. stretch was awarded to Price-Poole of Canada, Ltd.—a joint venture of H. C. Price of Canada, Ltd. (Calgary), and Poole Construction Co., Ltd. (Edmonton).

As PG&E's construction man Ralph C. Dodge, ANG's field observer on the Schedule, sums it up, the big problems are rock, mountains, and lack of access roads. And a real costly problem to the contractor is obtaining padding and shading material.

During the past winter, three crossings of the Moyie river and one on the Kootenay were completed. A crossing of the Elk river was missed by just a week as an unusually warm spring caused a fast snowmelt that brought on high water well ahead of when it was expected. ROW work and other crossings were also winter-worked, but were hampered by periods of continual snow and, later, rains.

The pipeline reaches its maximum elevation in this spread as it goes over Flathead Ridge at 7000 ft. Later it takes a long sharp descent into the Moyie River valley along rocky ledges. It gets into pretty fair, but heavily timbered, country as it approaches the meter station at Kingsgate, B. C. This installation is right on the Canada-United States international boundary.

Schedule 2—Schedule 2 takes the pipeline 146 miles from the Canadian line, through Idaho, to Rosalia, Wash.—just south of Spokane. H. C. Price Co. has the contract for this 36-in. schedule. Route follows the Moyie River valley to Bonners' Ferry where a river crossing was put in by River Construction Co. (Fort Worth).

Rolling farm and timber land takes over for the pipeline to pass through before hitting the next natural obstacle, the mighty wide and deep Pend Oreille river, near Sandpoint, Idaho. This crossing, another River Construction job, was put in early this year. Mud and more mud in the crossing approaches made this one a miserable task for pipeliners.

Schedule 2 hit some sharp slopes near Spokane that called for 35 deg grades. There is a scenic drop into Latah Creek valley and another at Rock Creek in this classification. And the Spokane river has to be crossed. In the immediate area of that city, hard rock crops up in range and farm land rather unexpectedly. It isn't too widespread, but it keeps the trenching machines pulling up and starting in again with regularity.

PGT's observer for the Schedule 2 work is W. L. "Kelly" Langston.

Through lodgepole pine in Dechutes National Forest of Oregon, lowering-in gang moves a long (and heavy) section of 36-in. mainline into the trench (Sch. 5, PGT).

In Northern California, PG&E's section of the line has mountains too. Here 36-in. mainline comes off a ridge and, taking one step at a time, lowers down into the Pit River valley. While it looks rather flat here, each "step" is considerably lower than its predecessor, and grades are steep (Sch. 6, PG&E).

Schedules 3, 4, and 5—U. S. A.: Schedules 3, 4, and 5—comprising 465 miles of 36-in. mainline—were awarded to the joint venture of Western Pipeline Inc. (Austin) and J. P. Neill & Co. (Dallas).

Schedule 3 calls for 152 miles of pipeline construction and generally passes through rolling grain and other cultivated areas, with stretches of rock mixed in. Chester W. Bond, PGT's observer, pointed out the Snake river crossing, Juniper canyon and fine, drifting sand by the mile as problem areas.

The Snake river is wide and swift where the pipeline will cross. Missouri Valley Dredging Co. (Omaha) had made one pass at it at the time I was on the line and then decided to wait for the heavy run-off to get out of the mountains before trying again.

Juniper canyon, just over the Oregon border, was a nice challenge to pipeliners' skill. Its south wall drops almost vertically for 600 ft, and the north wall isn't much of an improvement. The south wall was right-of-wayed with bulldozers. Rock was hit and had to be drilled and shot to get the trench 6 ft below the ROW —and that 6 ft was in solid rock.

After blasting, a backhoe was strung to the canyon floor and winched up as it dug trench. Rock spoil had to be yo-yo'ed up. Yo-yo'ing was also used on the considerable padding required. Then, pipe was installed by stovepiping from the south rim. To hold what they had, six 2500-sack, sack-breakers were built of sand and cement-filled sacks. The last step was a return to classic pipelining—the trench between sack breakers was backfilled by hand and shovel.

In the vicinity of Juniper canyon, for 80 miles, between the Snake river and Hermiston, Ore., desert-like sand was a problem. Perhaps it wasn't too much of a problem getting through it, but the problem was, and will be, keeping the pipelines covered as the wind blows and the sands shift.

The solution chosen was strawing the ROW after clean-up. This is simply a matter of spreading straw over the right-of-way and discing it in so that it stands up. For such a long stretch, it meant a lot of straw and a lot of discing—just another unusual thing that turned up on a long, cross-country pipeline project.

To build a schedule of cross-country, yard-diameter pipeline, it takes equipment. It takes big, rugged equipment and plenty of it. A look at *Table 2* shows what Western-Neill had in the way of major equipment to Build Schedule 3 alone.

Moving down the line, Schedule 4 had been spending a lot of time opening trench north of Bend, Ore., in

TABLE 2

Clearing and Grading Gang:

4 Tractors, D-8, dozers	3 Pickup trucks
2 Tractors, D-7, dozers	1 Tractor, HD-21
1 Fuel truck	1 Tractor, HD-19
1 Carry-all	

Stringing (Dunn Bros. subcontract)

2 Pickup trucks	1 Tractor, pipelayer
2 Automobiles	1 Crane, TL-25
11 Pipe trucks	1 Truck, gin pole
2 Tractors, tow	1 Jeep

Ditch Gang

2 Ditching machines, Cleveland 320	2 Tractors, pipelayers
3 Backhoes, 22B	1 Front-end loader, HD-9
2 Clams, 22B	3 Sets twin drills
1 Backhoe, LP-98	1 Air compressor, 600 cfm
1 Tractor, D-8, dozer and ripper	1 Truck
1 Tractor, D-7, dozer	10 Pickups
1 Tractor, D-8, dozer	1 Pickup, 4-wheel drive
	1 Carry-all

Line-up, Welding, Lowering-in Gang

4 Buses	1 Dope pot, 10 bbl
1 Fuel truck	18 Welding rigs, pipeline
2 Fuel wagons	2 Tack welding rigs
1 Buffing rig	1 Water pump, 2-in.
7 Welding rigs, utility	1 Truck, tack rig
3 Tractors, AC-16, pipelayers	1 Pickup truck
4 Tractors, AC-21, pipelayers	1 Tractor, D-7, dozer
1 Backfiller, Cleveland	1 Tractor, D-8, dozer
2 Water pumps, 6-in.	5 Float barges
2 Tractors, tow	1 Air compressor, 125 cfm
3 Trucks, flat bed	1 Jet pump
1 Dope pot, 23 bbl.	

Bending Gang

1 Bending Machine
1 Tractor, HD-16, pipelayer
1 Pickup truck

Dope Gang

2 Dope pots, 25 bbl	2 Trucks, flat bed
1 Tractor, D-7, tow	2 Pickup trucks
1 Front-end loader	

Cleanup Gang

1 Motor Patrol	2 Tractors, D-7, dozer
1 Tractor, farm, and disc	1 Truck, flat bed
2 Tractors, D-8, dozer	2 Pickup trucks

Miscellaneous

4 Trucks, mechanic rig	1 Trailer, float
1 Truck, grease	3 Parks vans
4 Trucks, winch	1 Office trailer
1 Trailer, lowboy	

some of the roughest rock country on the project. They had lava, slate, and a few other representatives of the hard-rock clan to contend with for mile after mile. This was drill and shoot, and real backhoe land. PGT observes Bennie Mills (Sch. 4) and Carl Whitmire (Sch. 5) dubbed it the toughest spread for right-of-way cutting and making ditch. Satisfactory padding and shading were extremely hard to come by and get to the trench.

Then, the John Day canyon was another highlight on this schedule. The pipeline approaches this natural block on a plateau. Sharply, the route drops off the plateau and into the canyon. Backhoes cut the trench down the grade while hung from three crawler tractors. The line picturesquely follows "30-mile" and Pine canyons for about 10 miles, approaching and leaving the main crossing of the John Day.

On Schedule 5, weather has been the toughest problem, according to PGT Observer Carl Whitmire. This 156.4-mile, 36-in. schedule started in on the California-Oregon state line, made some trench, and then had to shut down for two months. However, when the weather did start to smile on them, the spread really took off. It had a vexing stretch of rock on the southern end, but it was known to be there and didn't cause unusual disturbance.

To make up for that rock, about 100 miles of volcanic ash and pumice stone were hit. In this, trenching was a dream, though the ditch had to be sloped quite a bit. The contractor produced some of the prettiest trench on the whole project in this soil.

Rivers to cross in the schedule were the Lost, Sprague, and Williamson. All are in and were installed by Western-Neill.

Schedule 6—U. S. A.: Schedule 6 is the in-California section of the big 36-incher. PG&E's own forces are supervising construction, engineering, and inspection on this 296 miles. The H. C. Price Co. has the contract for 292 miles from the California border to almost into Antioch.

While the Canadian Rockies, Juniper canyon, John Day canyon, etc., are rough, the northern part of the California section can just about match any schedule for pipelining obnoxiousness.

The first barrier is lava flows in Modoc, Siskiyou and Shasta counties. More than 100 miles of it stretch between the Oregon-California meter station and south of Burney, Calif., where the line starts to come out of the Cascade range.

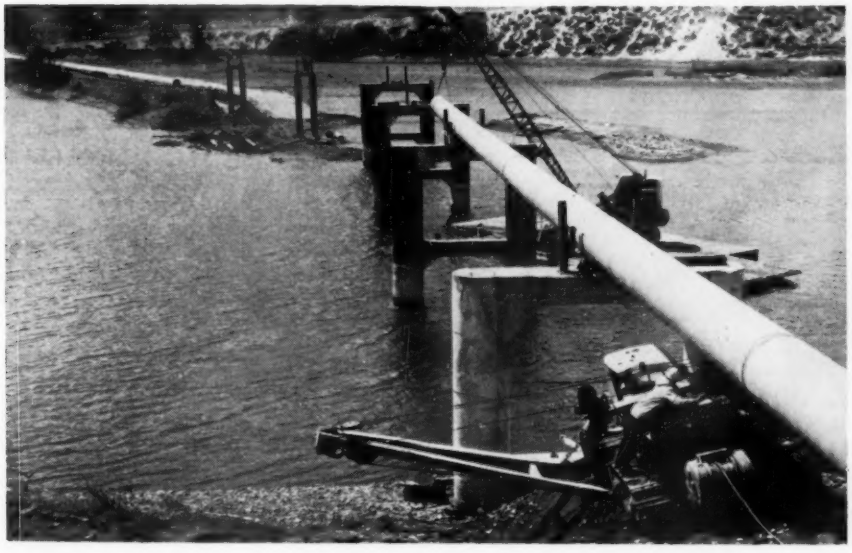
The contractor's people have been heard to express the opinion that all of Modoc county is solid lava. It is mean stuff and it's hard to shoot a good sharp-walled trench in because lava's porosity seems to absorb more than you'd like of the charge's force.

However, a technique was developed to produce the desired trench with clean walls, minimum width, etc. First, as much earth cover as possible was stripped off. Tractor-suspended quad and twin drills were next brought into action. Charge holes were drilled 36 in. apart on both side of the 48-in. trench line.

Powder men inserted three sticks of 40 per cent dynamite in each shot-hole, added war-surplus TNT flakes to almost fill, and put a cap of tamped earth on. Ten-foot long fuses were provided for each shot-hole.

Two chaps—who regale in living dangerously—each ignited all fuses on one side of the trench. This was done as rapidly as possible and I didn't observe any pauses for reflection after a fuse started to sizzle. The fuse travel rate was one ft/min., so the men had about 10 minutes to light all fuses in the 500-ft+ length normally blasted in one shooting, and hunt some cover. Delayed blasting gave the best results, and is very effective in lava.

Happily, a fine grade of selected material was generally available adjacent to the trench for padding and shading, so long hauls were not necessary. Pan-



Crossing Lake Britton near Burney, Calif., the 36-in. line is walked out over supports remaining from an abandoned highway bridge. Pipe will elbow down to earth-fill dyke (left foreground) which will take it to shore (Sch. 6, PG&E).

type earth movers did this work.

In the Burney area, there was true mountain country to be bested. Elevations between 5000 and 6000 ft were common in the Pit River country which is actually a shoulder of the Cascade range. There is a long series of sharp steps as the pipelining drops out of rugged ridges to approach Lake Britton, where the Pit river and Hat creek feed into that body of water. The lake crossing is made on recently reinforced supports remaining from an old highway bridge and a long stone-earth fill.

From the Pit River country, the big line starts a drop that will take it 5000 ft down into the Sacramento valley. That would be a good drop even up in British Columbia.

To my mind, two things stood out on the California section of the pipeline. These were the grading of ROW and trench, and the padding and shading. As performed on Schedule 6, they were as good as you will find on anybody's pipeline in rough country.

Credit for the grading goes to PG&E engineers who surveyed the right-of-way set grades for both ROW and trench. Grade was checked on trench bottom. You didn't see bending that a little right-of-way cutting would have eliminated. You didn't see two-toeing on the line; and when that pipe was lowered-in, it definitely fit the trench.

Best effort by the contractor and good inspection were producing the excellent padding and shading.

H. C. Price Co. had its line-traveling automatic positioning welder out on the California section in experimental use from time to time. It made some 50 welds before and during my visit to the spread. These were the filler and cap passes, placed over manually welded stringer beads and hot passes. They then ran into some problems requiring adjustment, but of the first 50 or so welds, none was unsatisfactory.

This unit uses fairly rapid oscillation of the welding head. The arc is shielded by a stream of carbon dioxide. The pipe does not have to be rotated as the welding heads make a 12 o'clock to 6 o'clock pass clockwise; then the same pass counter-clockwise, or vice versa, on a ratchet track. It very neatly filled and capped the 60-deg groove and 1/16-in. root gap when we watched it work. A big advantage of this machine is its compatability with conventional clamps, and with conventional bevel and land. While it is still under development, it looks promising.

On PG&E's section, mainline block valves were shipped from the factory with tees and fittings welded on. Shop welding with automatic submerged-arc equipment produces excellent quality and eliminates two heavy—hence, time consuming—welds in the field. This practice has worked out very well.

Direction of Schedule 6 construction is the responsibility of M. H. "Hap" Chandler, PG&E manager of gas construction. Project field superintendent is Ray Wetter.

CONCLUSION

In the fall of this year, providing no force majeure of consequence crops up, activity will start to drop

Small bulldozer distributes padding in ditch in northern California. Padding and shading on this section were outstanding (Sch. 6, PG&E).

Lava is blasted as trench is made in northern California. The contractor on this spread developed a special blasting technique that was very successful for efficient shooting on lava flows (Sch. 6, PG&E).

off along the Canada-to-California gas pipeline. The 4000 or so spreadmen will fade away over the nation. Some will even move on to pipeline in distant lands.

The clank and metallic squeal of tractors puffing through the woods will die out. Reverberations of explosives shattering rock will no longer set wild creatures affright with echoing from ridge to canyon and across quiet lakes. Small grocery stores in equally small towns will no longer experience the gay periods in early mornings when the pipeliners would stomp in full of jest and jabber to pick up the staples of their jungle lunches. Travelers of the highways will no longer wonder at the extra-long pipe trucks taking a "load of holes" to the right-of-way for stringing. Major pipeline construction activity on the project in four states and two Canadian provinces will progressively drop off, slow down and then grind to a stop.

There will be relatively little left to see. For the pipeline will have been put to bed. Its place of repose is in the earth with an average of at least 3 ft of cover. Remaining will be a cleared 100-ft wide strip rolling along in fair harmony with the lay of the land. True, it will be marked for the eye of the experienced gas man; compressor stations will chug or whine away at distant intervals; and here and there a valve extension will break the surface or launcher tubes will give evidence of the system. But for the most part, this pipeline, like its predecessors, will have been swallowed up by the earth and will be relatively unseen and unheard from birth throughout its life.

Buried with it will be years of detailed planning; countless reams of paperwork; miles of design and engineering drawings; earth-circling (in total distance, though not in scope) miles of personnel travel; and immeasurable days and nights of mental and physical toil by thousands of men and women. The pipeline's construction period will have brought excitement and happiness to some of the builders. To a very few it will mark tragedy. To most it meant a period of new experience, new country, and new accomplishment.

A new pipeline's burial happily marks the start of a new era. In the case of this pipeline, it starts a new phase in Pacific Gas & Electric Co.'s life. Never before has this company reached out of its home state with a project under its own control for new gas supply. It means connection of virgin Canadian gas resources that will assure the company's ability to meet gas needs from all customers in the very challenging years ahead. It demonstrates the will and ability of an investor-owned utility to progress and keep ahead of requirements from its consuming public without government action or subsidy. It demonstrates the product of friendship and cooperation between two fine, strong North American nations for all the world to see.

Earlier in this article, some of the history of Pacific Gas & Electric Co. was unfolded. That was the era of Peter Donahue, George H. Roe, Eugene J. de Sabla, Jr., and so many, many others who have guided this great company to its place of eminence and respect in the American business community. They did great things. They brought great benefits.

I don't like to think, however, that all history is past. This gas pipeline project linking Alberta with the Golden Gate is dynamic modern history. And the builders of this project should take their place in Pacific Gas & Electric's history along with the builders of the company.

Directors, officers and executives of Pacific Gas & Electric, Pacific Gas Transmission, Alberta Natural Gas, Alberta & Southern, and Alberta Gas Trunk Line, etc., are certainly part of this modern history. Their concepts and accomplishments in the many facets and phases of their companies' development will be adequately recorded elsewhere.

The history makers in a modern history of a pipeline project are the actual pipeline builders. Thousands are involved and each will take his place through the recording of just a few.

Such men are Ray Wetter, project superintendent; Walter Funabiki, project engineering; Al C. Fantozzi, project engineering; and many others with PG&E who were out in the field constantly or from time to time on the in-California segment.

Then, on the Pacific Gas Transmission section, men making modern pipeline history every day were Carl Whitmire, Bennie Mills, Chet Bond, and Kelly Langston; with Ralph Dodge up in British Columbia for Alberta Natural Gas. Joining with them are Jim Knowles and Mike Halverson for Alberta Gas Trunk Line.

Men of Alberta & Southern have worked for years on the project's Canadian gas contracts and related matters. Charles Pennypacker Smith and Robert Blair have helped write this chapter of the modern history.

The work of still others will not be forgotten as this project operates through the years, nor will they forget the project. There's H. W. Haberkorn, vice president in charge of general construction; and M. H. "Hap" Chandler, manager of gas construction—both of these PG&E men have lived with the pipeline for years in office and field. Another who has put a lot of himself into the pipeline is PG&E's Roscoe D. Smith, manager of gas system design.

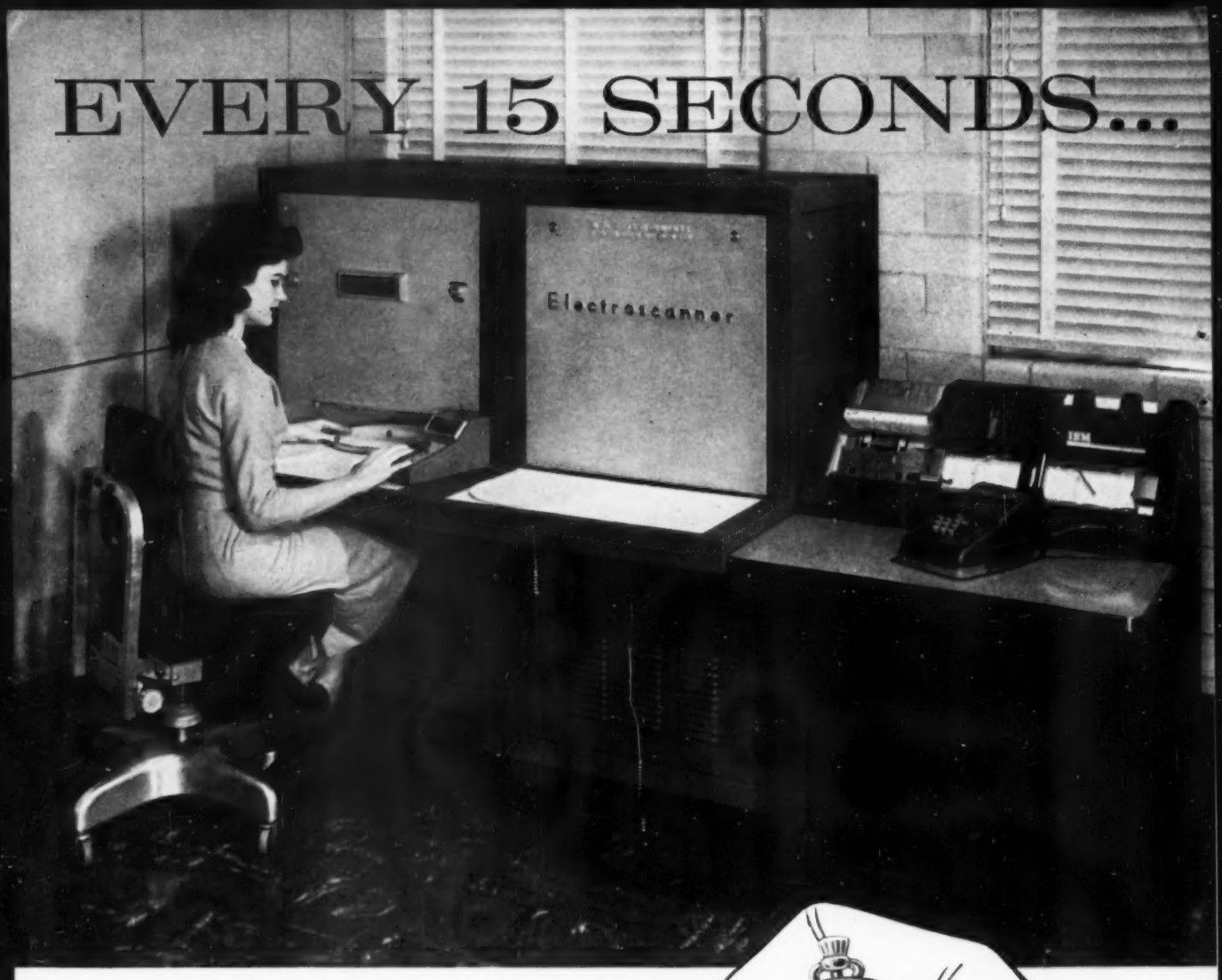
Pacific Gas Transmission's John G. "Jack" Smith; F. W. "Peter" McChesney; and Ralph Nabors are modern pioneers writing another chapter in Pacific Gas & Electric's history. Associated with them in this respect at Alberta Gas Trunk Line Co. Ltd. are J. C. Mahaffey, executive vice president, Eldon Hunt, John Ballachey, and Walter Hopson.

Such men could not build this project alone. Nor would they desire credit for doing so. But they are typical of the spirit and desire exhibited by all personnel associated with the big pipeline.

Through them, then, we salute the builders of this mighty energy-moving pipeline and the many companies in the several capacities associated with its conception, design, engineering and construction.

Earlier we repeated a call from bygone days for ". . . men to match my mountains." The call has been answered. The men are there. The mountains and many other obstacles to construction of the Alberta-to-California 36-incher are being matched. ■

EVERY 15 SECONDS...



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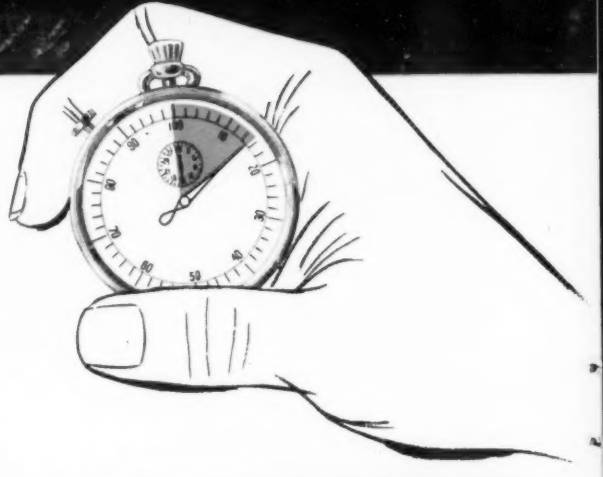

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By KEN KRIDNER • Engineering Editor

Selling gas by the pound

MY hat's off to likeable E. N. "Army" Armstrong of Transcontinental Gas Pipe Line Corp. for speaking out his opinions on the use of mass measurement of gas flow. Army is one of the oldtimers in the gas measurement game and his opinions are valued. He stood up to be counted at the recent AGA Transmission conference in Denver. C. W. Brown, measurement superintendent for Texas Gas Transmission, and Ye Ed, Fred Ebdon, spoke before the assembled measurement men and discussed the subject of mass measurement.

Brown stressed the American public's acceptance of the pound unit when spending its purchasing power. Marketing of natural gas by the pound would be in line with accepted practices. And selling gas by the pound would point up how inexpensive gas really is. A pound of gas selling for 90 cents per Mcf (@ 1000 Btu/cf) would sell for *2 cents* and contain approximately 25,000 Btu. If psychology is necessary to obtain approval from the American public—then what could be more effective than pricing natural gas *at only 2 cents/lb?*

To sell by the pound, we must measure by the pound. It appears that the industry is giving deep thought to new measurement procedure. A manufacturer of mass flow meters states that his company is receiving numerous inquiries for data, cost and application of its meter.

Brown, in his Denver talk, brought out the necessary ingredients for a mass meter if it is to receive industry acceptance. He said that the mass meter must: give accuracy comparable to the orifice meter, be rugged, be self-contained, offer a permanent record of gas passed, be adaptable to field calibration, be reparable in the field, have a wide range, be portable and, last but far from least, be economical. If any manufacturer is still interested after reviewing this impressive list of requirements, then he is invited to accept the challenge and jump in—the water's fine.

As I discussed in this column last month, I believe the future of gas measurement is in the use of instruments measuring mass. But considering the number of gas meters in use at this time and the attitude of most companies towards standardization of equipment, complete acceptance of mass measurement may be "several" years in the future.

The three-day joint automatic controls conference sponsored by five of the major engineering societies held at the University of Colorado was very enlightening to me. It pointed out how little I actually know of recent developments.

Approximately 60 papers were presented by leading experts in their respective fields. Aside from the meeting, I enjoyed a conversation with Schuyler Patrick, administrative assistant, Bureau of Continuation Education at the University of Colorado. He pointed out that 90 per cent of the world's engineers are living in our time, indicating the stress placed on knowledge in this century. And scientists are presented with a tremendous problem to disperse the vast quantity of technical data that is being collected so rapidly.

Conferences sponsored by multiple engineering societies are an effort to reach the largest number of technical people with the least amount of time involved. As usual, our conversation turned to the accelerated pace at which we live and the rate of new developments. Patrick's comment was—"Admitting we are moving at a fast clip, *can we afford to stop?*" Food for thought to those of you in industry today. Particularly in the field of gas measurement and automation.

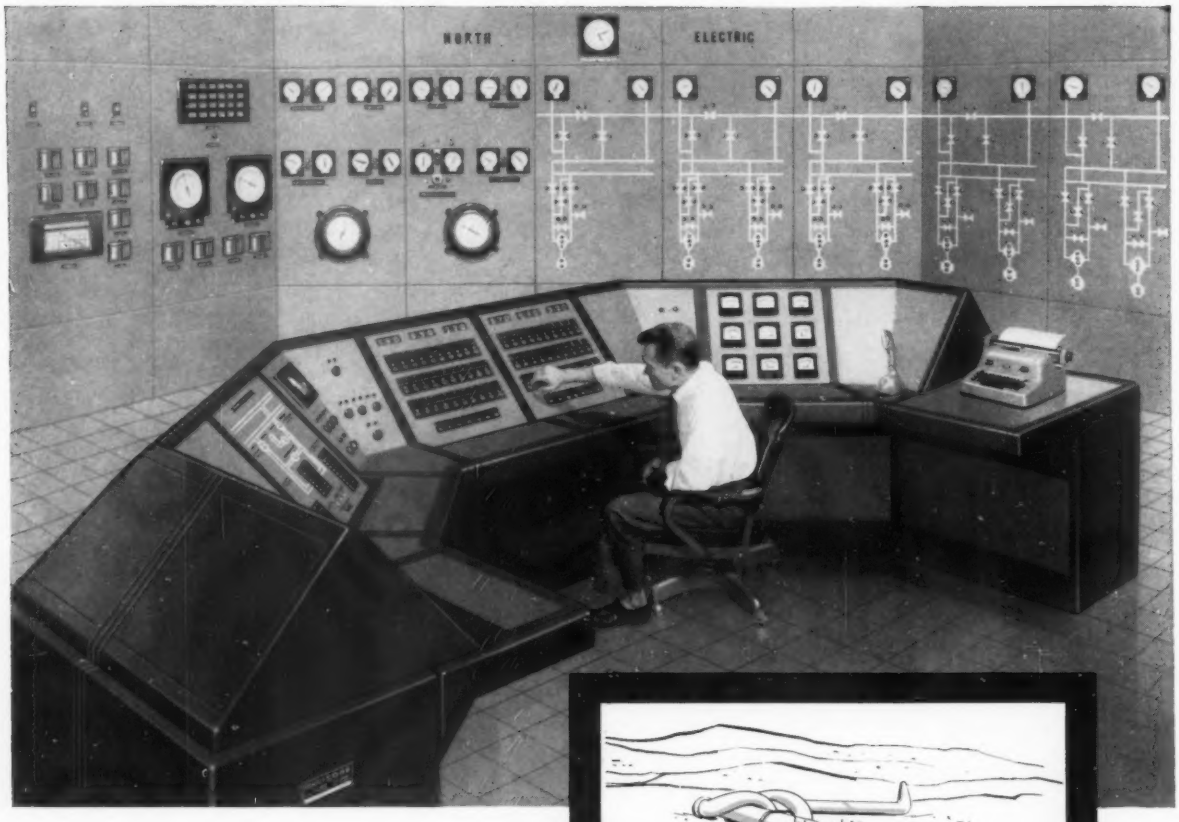
We are making advancements in techniques and equipment by giant strides. The gasman of yesteryear required only a knowledge of what gas was and its handling. The gasman of the future will have to be versed in electronics, in physics and in economics if he is to stay abreast of developments in his field. The rate at which the field of automatic control alone is growing is emphasized by the stress placed on integration of analog and digital computers in the recent automatic control systems.

My years on the payroll of Colorado Interstate gave me the opportunity to view developments in measurement and automation. But, I was particularly pleased with my small part in the educational program presented for the measurement engineers (later reclassified as meter inspectors) of the measurement department. Fourteen of the fieldmen were enrolled for a course of study stressing natural gas engineering. This course was intended to give the men a strong basic knowledge of the gas industry.

That six of the men completed the 30-month course of study on their own time is commendable. My personal congratulations go to Cecil Flanagan, R. M. "Dick" Scanlon and B. A. "Boo" Ross of Amarillo; to Paul W. Henderson and Fletcher W. Scott of Denver; and to W. L. Scott of Colorado Springs —for their successful completion of this course. If you happen to run into any of these men, ask them their opinion of benefits to be gained from additional study. And congratulate them for their good work. To the remaining eight who are continuing their studies, I extend my best wishes for their early success.

There are many others of the readers of M-A-C who are also improving their knowledge through home study courses and by attend-

Continued on page 148



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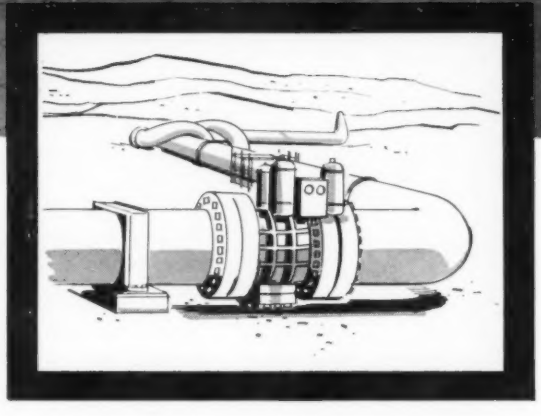

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Communications Tele-Control

By F. VINTON LONG

What is this high speed stuff?

THE other day I picked up a magazine and read an article entitled "Supervisory Control" of a pipeline. I thought I could learn something from it, but I did not.

The reason I did not was because it described a simple telemetering system, of slow speed, with, I'm sure, none of the values being used for billing nor much of anything. And there was zero effective control.

That is at least an advance on phoning in some pressures and things from outlying points.

But not much better.

Not so long ago there were, to my knowledge, two, and only two, suppliers of supervisory control equipment that would work over noisy and bad circuits, such as microwave when it was at its worst (with fades and resultant "white noise").

In case you-all aren't microwave men and want to know what happens when microwave links fade out, just watch your TV screen some warm summer night and you will sometimes see the picture become filled with white spots, gradually becoming worse, until Bell switches it off and your station shows an announcement saying "cable failure." It usually is not cable failure, but simply summer temperature inversion fades in their microwave system.

Well, the same thing happens to privately owned systems, which are no better and often no worse than those of the common carriers. Plus that, there are often static or lightning bursts on land lines which shoot in some extra pulses on your supervisory control or telemetering circuits.

So that is why "sequential tone" operation has in the past been preferred to "pulse" dialing for vital control functions on pipeline and electric power systems which were subject to such interferences.

The first major supplier of this almost foolproof technique was Control Corp. The second was Motorola. Unfortunately, Motorola bowed out shortly because it felt there was too much engineering and too little profit from such an operation. So for many years Control Corp. was unchallenged in this field and, in fact, still is. However, the equipment requires a voice grade channel for operation.

The change from this philosophy was first made by AT&T, which frankly declined to quote a major pipeline project with conventional pulse dialing control equipment because AT&T felt it was unsafe over long distances.

So they came up with the SC-2 control system, which operates over a slow speed telegraph line and has a code protection which is most foolproof.

After this, several suppliers have offered so-called pulse dialing with parity bit checking, and sometimes double transmission in the manner of the SC-2, and it works just fine.

So now, in this last year, you pipeliners have several good systems to choose from, and most of them are safe to operate.

Many of these operate on the digital technique, and these operate with about the same speed; that is, they can use a slow speed cheaper leased line circuit for operation. This would be a "signal grade" of about 75 cents per mile monthly.

All this is well and good, but suddenly there jumps up the requirement for a pipeline or two where higher speed is needed.

It's not really required for commands or supervisory control, but it could be useful for high speed digital data handling.

So if we begin to think about a complicated pipeline system, with a lot of values coming in to a central computer, the time of transmission of data values begins to count up. That is why some companies are taking a long look at high speed tele-control.

As I said before, only the incoming data would be high speed, but in many cases the supervisory control gear is common with the data control equipment, so both wind up with a fairly high speed.

One way to get it in to "central office" in a hurry is to use solid state (transistor) devices, and have the home office scan each outlying point in turn and ask for a super-rapid readout.

Of course, this whole mess comes in too fast for even a typewriter to print out, so some sort of storage equipment is needed to hold information for the typewriter.

If a computer is permanently connected to the line, of course its memory could store all this data (if it doesn't go crazy) and the typewriter could work off the computer.

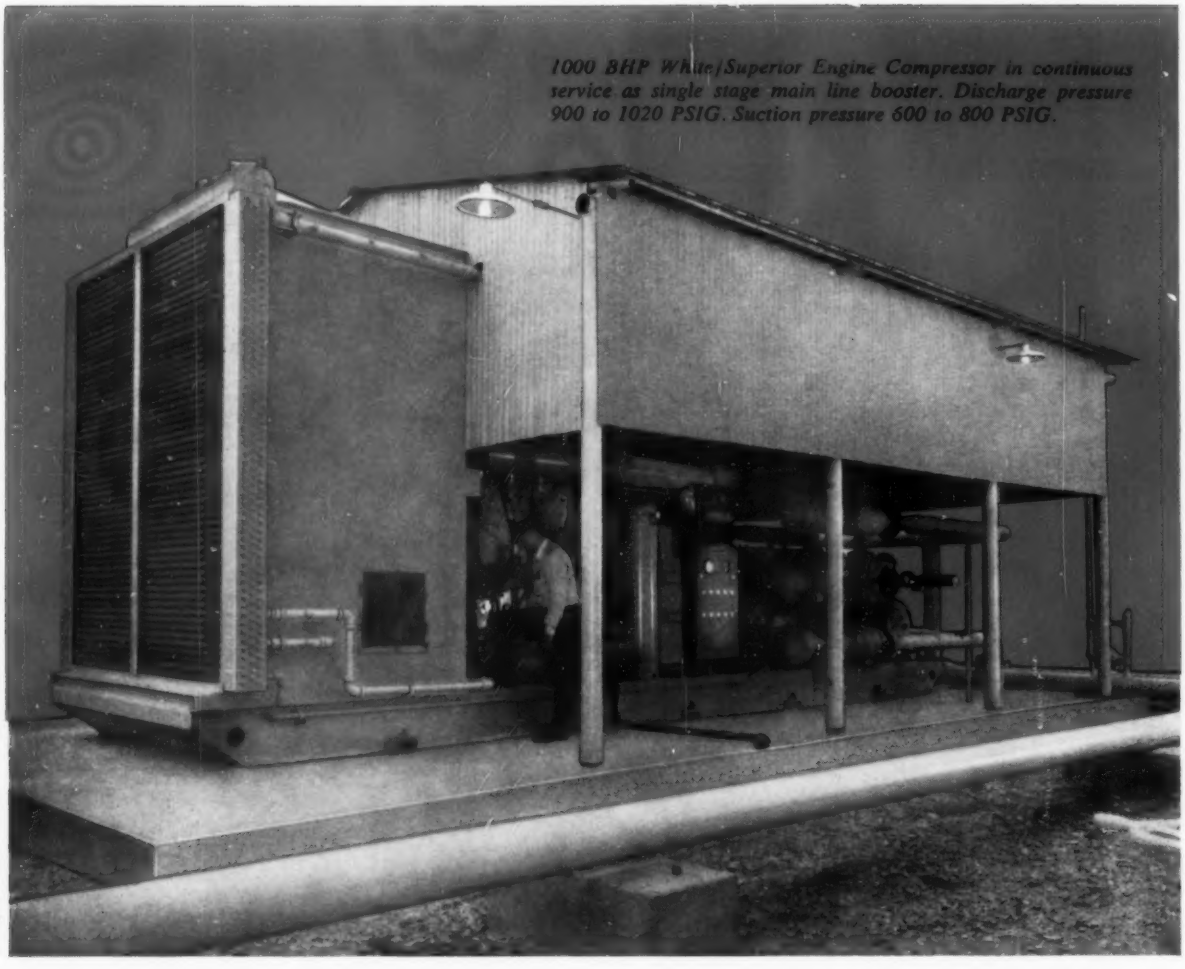
Of course, if you don't know what to do with it, there is no sense bringing in all that stuff so fast, anyway.

But, assuming we have a lot of pump or compressor stations, and sales and purchase points, then we would need a lot of data in a hurry.

And in that case the high speed operation would "prove in."

I think the biggest shock to management comes when they find out that the old law, "You can't get something for nothing," irrevocably applies to data handling over any type of communication channel. If you desire speed, you have to pay for it in several ways: (1) money—higher grade communication channels; (2) chance of error—bad grade communication channels can really drown out the show; (3) possibly more sophisticated equipment with increased standard of maintenance knowledge.

So, which do we choose? ■



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White's medium speed, heavy duty, balanced opposed compressors—200 to 1000 BHP—are specifically engineered for direct drive combination with Superior natural gas engines or electric motors. Two, four and six-cylinder models offer cylinder sizes from 4000 PSI, 2⅝" dia. to 85 PSI, 22½" dia., providing 68 different cylinders. Custom sizes and designs are also available.

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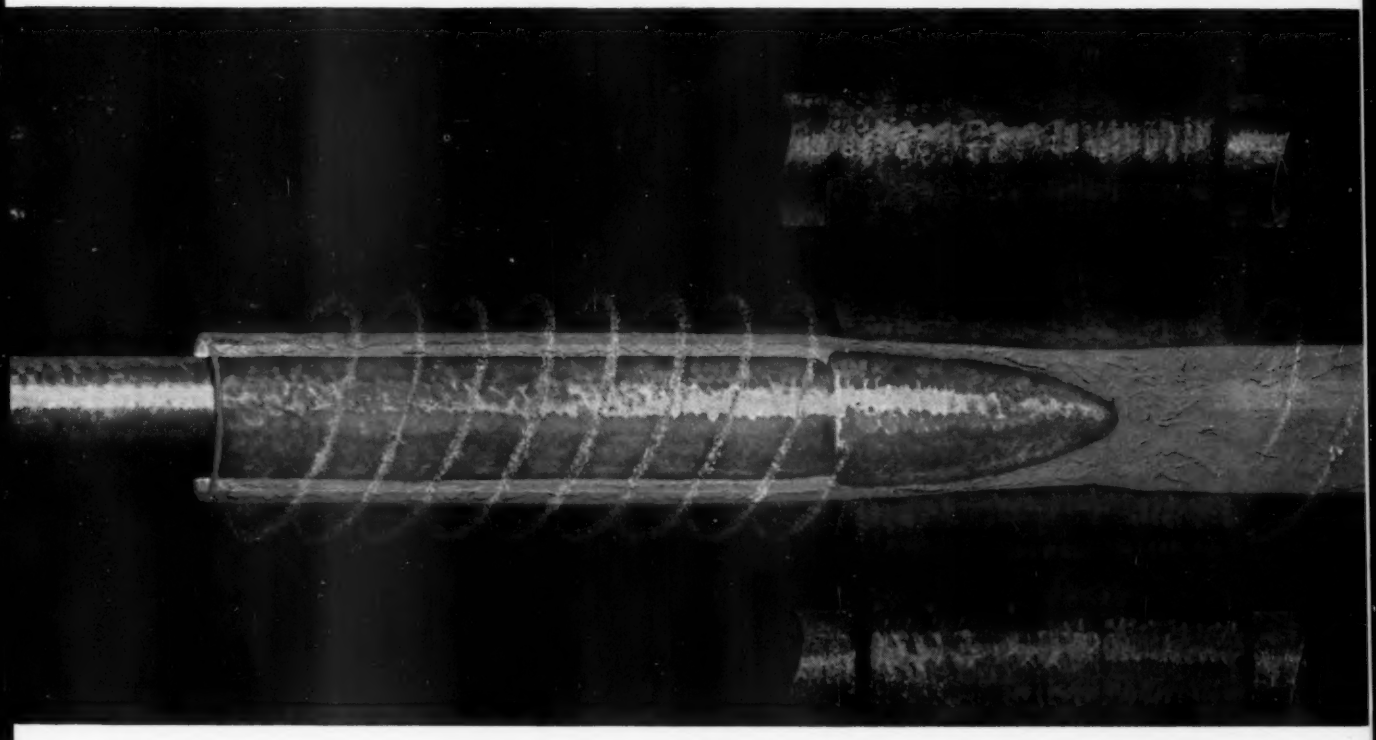

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SRS Pipeline People

N. W. FREEMAN, veteran executive of Tennessee Gas Transmission Co. and president of Midwestern Gas Transmission Co., has retired. He remains on the boards of both Midwestern and Tennessee Life Insurance Co., TGT subsidiaries. W. C. MCGEE, JR., president of Tennessee Gas Pipeline Co. and a TGT director, will add the presidency of Midwestern to his other duties.

W. R. NIBLOCK named manager of planning and analysis with WELLS E. HUDSON as sales manager of industrial coatings for Protective Coatings division of Pittsburgh (Pa.) Chemical Co.

Staff expansion in Youngstown Sheet & Tube Co. has created new positions which are filled by ROBERT H. FRAZIER, manager of applied research; JOSEPH W. LODGE, acting supervisor, new product development; DR. MELVIN C. CHANG, supervisor, raw materials research; DR. ROYSTON P. MORGAN, supervisor, physical metallurgy; DR. JOHANNES M. UYS, supervisor, iron and steel making; GEORGE H. DENTON, assistant supervisor, raw material research; JAMES L. BAYER, research engineer, mineral petrography; WILLIAM R. PATTERSON, research engineer, product research; HENRY J. OBERSON, research engineer, assigned to special duties.

J. D. Gilbride
Clark Bros.

Dee Jones
Stupp

JENNINGS R. LAMBETH joined steel service center sales division of Youngstown Sheet & Tube Co. as manager, with headquarters in Boardman, Ohio.

ROBERT R. PARK heads the newly formed department of gas market research for Texas Eastern Transmission Corp., Shreveport.

ROBERT M. JOHNSON is district sales manager of Stupp Corp.'s Denver office.

GEORGE M. WOODMAN is now a sales representative for White Diesel Engine division of The White Motor Co.'s Houston office.

DEE G. JONES is sales representative in Dallas area for Stupp Corp., Baton Rouge, La.

E. BYRON STOLLE is general manager of Crane Co.'s Midwest Piping division, headquartered in St. Louis. Stolle succeeds O. P. CARTER, assigned special duties with parent company.

G. S. LEONARD appointed manager of manufacturing of the Pressure Control Equipment division of Cameron Iron Works, Houston.

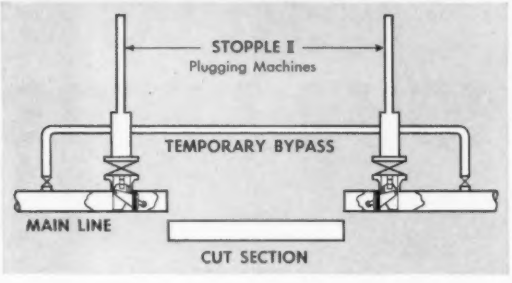
RALEIGH E. UTTERBACK named West Coast district manager for closed circuit TV equipment sales by General Electric's Technical Products operation in Redwood City, Calif.

JAMES D. GILBRIDE is California district manager in Los Angeles of Clark Bros. Co., one of the Dresser Industries, Inc., Olean, N. Y.

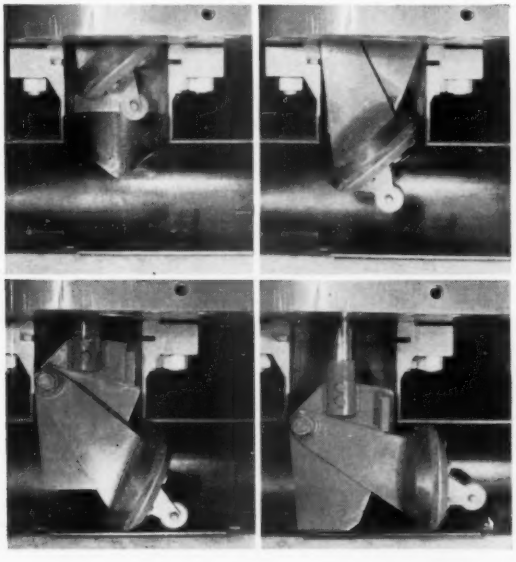
Three new assistant vice presidents of Natural Gas Pipeline Co. of America are: J. W. HANCOCK, Amarillo; J. I. POOLE and H. R. ROHWEDDER, both of Chicago.

Texas Gas Transmission Corp., Owensboro, Ky., announced four new appointments: WILLIAM B. THRELKELD, assistant corporate secretary; HOOVER L. GIBSON, superintendent of design and construction; WILLIAM T. TURNER, JR., director of planning; and PAUL A. FEDDE, director of research.

CHARLES L. RHODES promoted to branch manager at Hobbs, N. M., by Black, Sivalls & Bryson, Inc., Kansas City. ROBERT L. KELLY appointed product supervisor, automation equipment, Oklahoma City, and JAMES M. CLAYTON named branch manager at Shreveport, La.



❶ "This method of plugging a line and bypassing the flow has been used extensively in plant and field operations with WMSon tapping and STOPPLE equipment. Many costly shutdowns have been avoided. Now, WMSon engineers have re-designed and improved the STOPPLE Plugging Machine. Result . . . the all new STOPPLE II . . . offering hydraulic operation, improved, simplified construction, and economy—**real** economy!"



❸ "Here's how STOPPLE II works. After the tap is made, the STOPPLE II is mounted on a WMSon SANDWICH Tapping Valve, and the plugging head is lowered into the line, stopping the flow completely. New single link construction of the plugging head offers built-in simplicity . . . and strength for high pressure plugging."

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NEW economy
NEW improved design
NEW interchangeable plugging heads . . .

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Plugging Machine for piping modification or repair WITHOUT SHUTDOWN!

❷ "Here's the major reason for this economy. The STOPPLE II has a hydraulic cylinder that is interchangeable with plugging heads of different sizes. For example, one hydraulic cylinder can be used on a 14", 16", 18" or 20" line by using it in combination with a plugging head and housing of the proper size."

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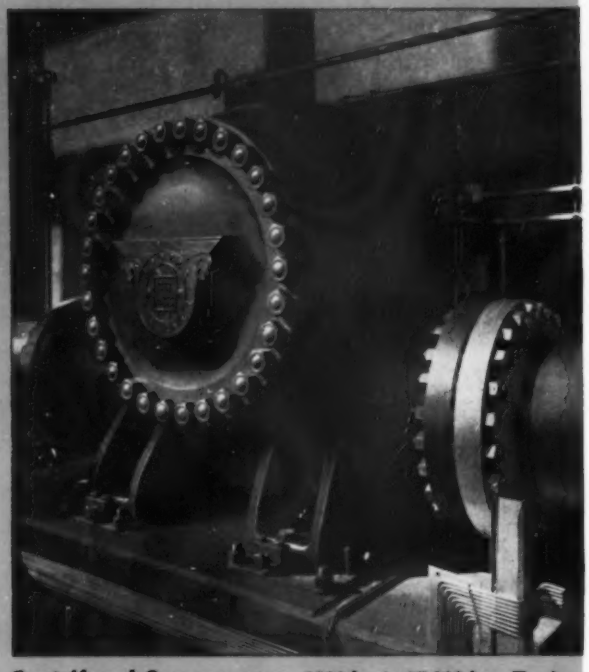

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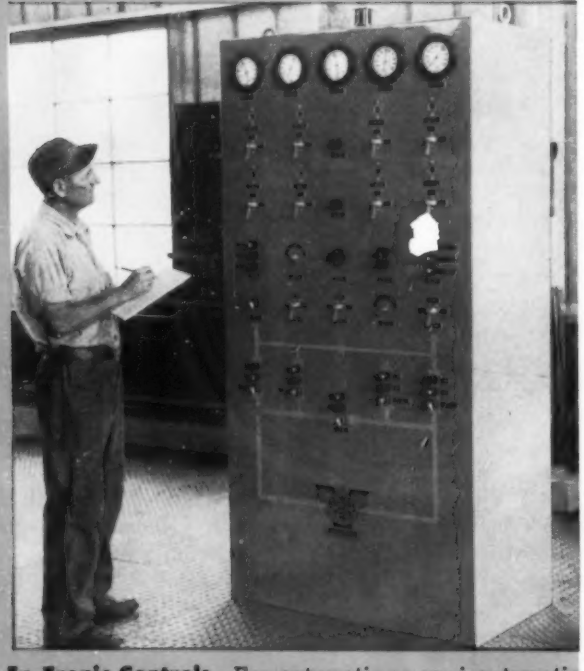

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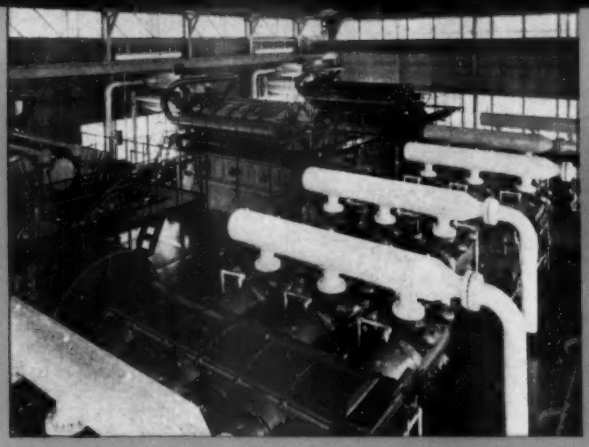
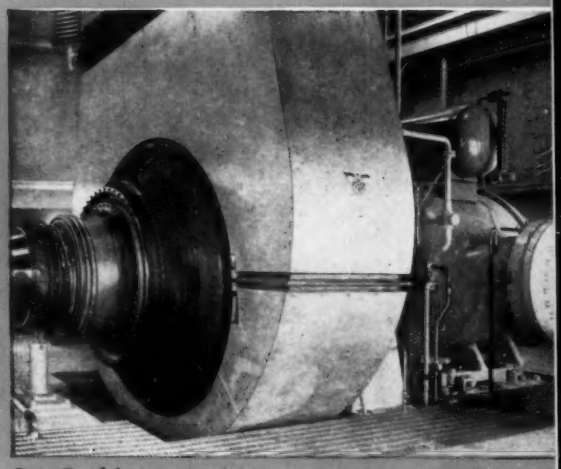
Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

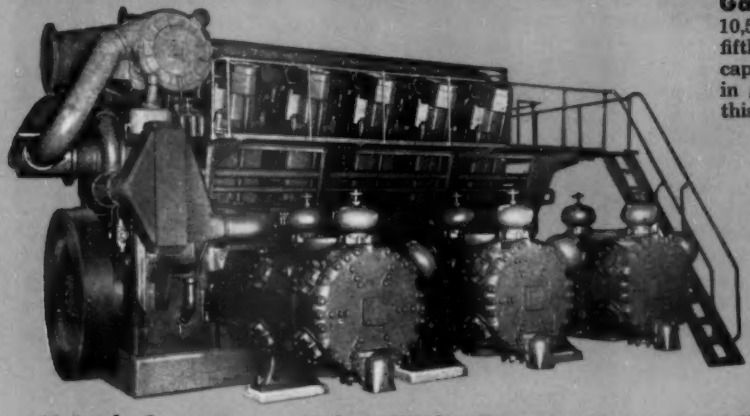
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINES: GAS - DIESEL - GAS-DIESEL
JET-POWERED GAS TURBINES



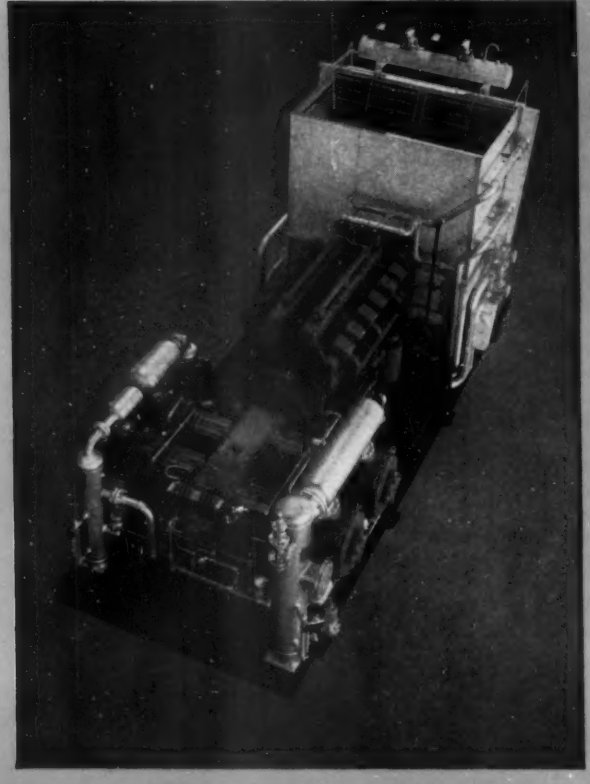
Compressors for Every Drive—100 hp to 10,000 hp Adaptable to engine, motor or turbine drive; horizontal reciprocating · Service: Gas processing, recycling, transmission, refinery, petrochemical and industrial or process air.

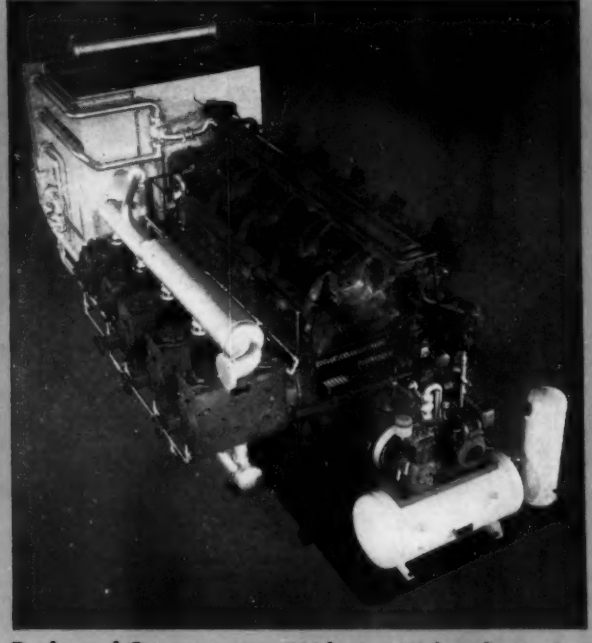


Gas Turbines—Cooper-Bessemer jet-powered 10,500 hp RT-248 gas turbine weighs less than one-fifth as much as conventional gas turbine of same capacity. It is shown driving main line gas booster in gas transmission. Write for further details on this and other C-B gas turbine units.



V-Angle Compressors—265 hp to 3500 hp · Gas engine compressor centrifugally aspirated, or series turbocharged · Service: Main line transmission, gas lift, storage, gasoline extraction, refrigeration, refinery and petrochemical processing · Shown above: Cooper-Bessemer Model GMWC Compressor.

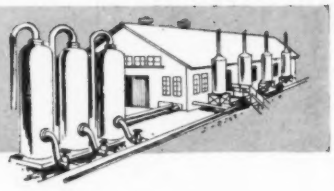




Packaged Compressors—100 hp to 1100 hp · Gas engine driven, completely packaged, prepiped and skidded, by C-B Southern · Service: Field-to-line booster, pressure maintenance, gas lift, repressuring, refinery processing, extraction, plant air.

Shown above: *(Left)* Cooper-Bessemer Model AM-4 unit. *(Right)* Cooper-Bessemer Model GMXD-10 integral V-angle unit.

GAS PIPELINE NEWS



Coal wants end-use control

Despite testimony from coal interests to the contrary, Columbia Gas System's new president John W. Partridge charged that the national fuels study actually seeks to replace free consumer choice of fuels with end-use controls.

Partridge was addressing the Senate Interior and Insular Affairs Committee on Senate Resolution 105. He said that the resolution "sponsored by the coal industry, is a major step by the coal industry to restrain competition in the fuel markets." And, "if enacted, would be the first and most important step . . . toward the eventual establishment of some Federal commission or bureau for the allocation of energy and fuels."

Partridge declared that "if there is any question in the minds of the committee that there is an imminent shortage in the energy resources of our nation today, or the foreseeable future," then he urged the committee itself to make the study. ". . . It is eminently qualified both by past experience and by reason of its ably equipped staff, to undertake a study of all fuel resources."

"Such a survey," he said, "if allowed to proceed calmly and objectively, must bear out what previous studies have found. Namely, that America's fuel resources are ample for today and for the foreseeable future."

Columbia's Gas System's management recognizes the national importance of adequate fuel resources and the legitimate concern of Congress that available reserves be accessible to consumers. But, Partridge declared "no one can come before this committee today and charge that the American people have not been supplied with an abundance of fuels" nor that there exists any "imminent shortage" of fuels.

"Moreover, there is no evidence that our nation is confronted suddenly with an emergency or crisis in our energy picture," he added.

Since no crisis exists or can be foreseen, "the issue . . . here is not whether a study of America's fuel reserves should be made. The real issue is whether or not the American principle of freedom of choice —freedom to use available energy and fuel resources will continue to survive, or whether it is to be transplanted by some kind of planned allocation or restraint.

"The only purpose, the only drive behind S.R. 105 by the coal industry, is directed toward the eventual establishment of end-use controls on the U. S. fuel industry—and end-use control which the coal industry hopes will give it a competitive advantage by government direction."

Partridge took up coal industry charges that the natural gas industry sells to industrial consumers below cost. He said Columbia operating companies "represent a very major segment of the gas industry," and that "no company of the Columbia Gas System sells gas for any industrial purposes below cost. As a matter of fact, our policy is contrary; we seek to charge for our industrial gas prices that fully cover the cost of rendering the service."

In contrast to Partridge's contentions were those of Joseph E. Moody, president of the National Coal Policy Conference Inc., George H. Love, chairman of the board of directors of the conference and chairman of the Consolidation Coal Co.

"Today I do not feel I exaggerate at all when I say that we actually face a crisis regarding our basic domestic fossil fuels," Moody declared.

Moody said that, "although the coal industry has been the hardest hit during the past 20 years of inaction, it is not alone in needing positive and constructive action to help improve its problems today."

He suggested that among "fields of inquiry" which could "profitably be a part" of a fuels study is the tremendous area of fuel transportation—oil and gas by pipeline and coal by the railroads.

He said the transcontinental pipelines are "beset by many problems."

California studying in-state production

California is going to look into the natural gas production industry in the state. PSC president Everett C. McKeage said the study is to determine whether the commission should make recommendations to the state legislature for laws authorizing the commission to regulate the entire in-state industry. California law does not permit PSC regulation of the sale of natural gas at the wellhead, its regulatory powers extending only to public utilities distributing gas to the consumer.

The matter of wellhead regulation of natural gas by the commission figured last year in the case involving the supply of gas by Richfield Oil Corp. to Southern California Edison Co.'s Ventura electric generating steam plant.

The commission said it had a right to regulate the sale and transmission of the gas. However, the state supreme court ruled that Richfield was not a public utility and the commission was without jurisdiction.

About 25 per cent of the natural gas used in California comes from in-state production.

Contract completed for Ship Shoal gas

Two Tennessee Gas Transmission Co. subsidiaries have completed purchasing lease-hold rights in the Ship Shoal offshore area of Louisiana from the CATC group. Involved are estimated net recoverable reserves of 533 billion cu ft of natural gas and 16.2 million bbl of oil and other liquid hydrocarbons.

Total consideration was about $97 million, including a $2.2 million down payment.

TGT subsidiaries are Tennessee Gas Supply Co., buying the gas reserves, and Tenneco Oil Co., which bought the oil reserves.

CATC group includes Continental Oil Co., Atlantic Refining Co., Cities Service Production Corp. and Tidewater Oil Co.

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Plastic gathering lines becoming "standard"

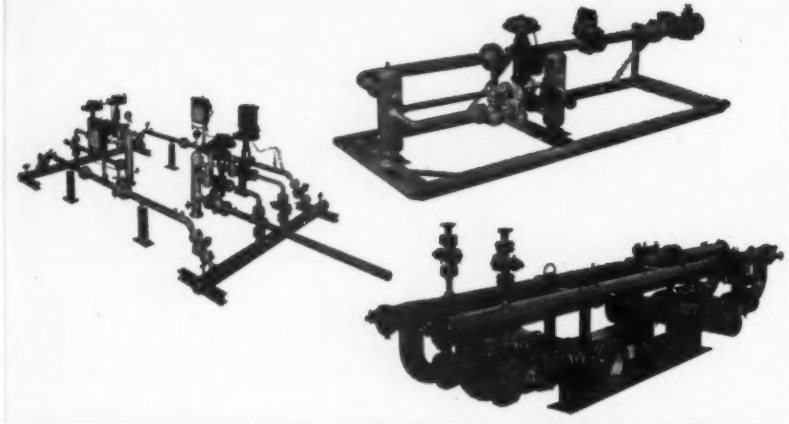
High density polyethylene pipe will be used as "standard" for gas gathering lines within five years, Phillips Petroleum Co. forecasts.

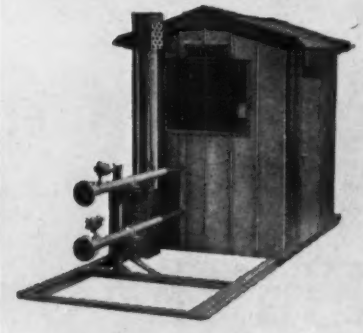
Behind Phillips' prediction is six years of testing plus the more than 2 million ft of Marlex high density polyethylene it has been using in its own oil and gas fields. Marlex high density polyethylene is produced by a wholly owned subsidiary, Phillips Chemical Co.

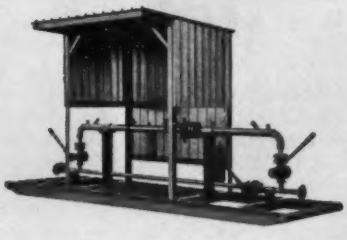
The plastics pipe is now installed on a routine basis by the company.

George Wash, director of Phillips plastics sales division, expects industry pipe sales will account for over 16 million lb of high density polyethylene this year—about 7 per cent of the estimated 233 million lb that will be consumed this year.

One of the factors convincing Phillips to use plastics pipe was the development of the "butt-fusion" joining technique. The Phillips-pioneered method is said to reduce joining time in the field to 30 seconds (see GAS, March 1961, pp. 135-137).







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Battelle testing pipe for industry

First field tests on pipeline steel are under way at the test site, six miles south of Athens, Ohio.

The experiments are being conducted by Battelle Memorial Institute; the research program has the backing of AGA and some of the nation's leading gas transmission and distribution companies. The industry committee in charge of the tests is headed by Baxter D. Goodrich, senior vice president of Texas Eastern Transmission Corp., Shreveport. Supervising the tests at Athens is Robert S. Ryan, supervisory engineer of the Columbia Gas System Service Corp.

The research involves subjecting pipe of various diameters to pressures normally used in transmitting gas over long distances. Pipe will be damaged purposely, prior to testing, to cause it to fracture under pressure.

An experimental pipeline, about 200 yd long, at the test site was built in three sections. Only the center section—about 150 ft long—will be fractured during the experiments. (See GAS, June, 1961, pp. 117-120.)

So far, plans call for six field tests this year on 30-in. pipe at various temperatures. Tests will be run a few weeks apart.

Similar experiments were made near Athens in 1953 (GAS, November 1953, p. 85). These earlier tests furnished information which was used in preparing the ASA code for pressure piping and provided companies with data which could be used in ordering improved steels for pipelines.

Northern's capacity boost okayed by FPC

Northern Natural Gas Co. has FPC's blessing on its plan to increase its system capacity by 174 MMcfd. Included in the $37.5 million project is authorization for Northern to sell 75 MMcfd of the increased capacity to Michigan Wisconsin Pipe Line Co.

Michigan Wisconsin also won approval of part of its expansion project. Denied was its proposed lateral line extending from Madison to Baraboo, Wis. This portion of the plan was approved by FPC presiding examiner Samuel Binder in March.

The opinion was prepared by Chairman Jerome Kuykendall, marking the first issued under FPC's new policy of issuing its important decisions in the name of an individual commissioner.

Northern's expansion is covered in three separate dockets. In all, Northern will build about 380 miles of line and install 20,660 hp in compressor stations. Involved are sales to customers in Wisconsin, Illinois, Michigan, Iowa, Minnesota, Nebraska, and South Dakota. The new facilities are designed to enable Northern to meet a peak-day capacity of 1.7 billion cu ft.

Approved portion of Michigan's plan covers 30 miles of 30-in. line and 3000 hp in compressor capacity. Cost: $4.4 million.

Michigan Wisconsin and two of its customers — Milwaukee Gas Light Co. and Wisconsin Power & Light Co.—entered into an agreement for the joint project under which the two distributors would serve communities in central Wisconsin. This is the plan declared economically unfeasible by FPC.

Digital control school held

Twenty-five men from 14 pipeline companies attended Dresser Electronics SIE division's school covering techniques of digital and solid state control systems.

Topics during the week-long session ranged from elementary control concepts to applied logic including the use of Boolean algebra. Logic circuits, their application and hardware used, gave students a basic foundation in modern control technology. First-hand experience and learning was assured by "home work" assigned each night. All classes were held at Dresser/SIE's Houston plant.

CIG subsidiary buys production area

Natural Gas Producers Inc. has purchased all the working interest in the Fort Morgan field unit, the Fort Morgan gasoline plant and all facilities related to its operation. NGP is a wholly owned subsidiary of Colorado Interstate Gas Co. The move strengthens NGP's gas reserve position in the area.

Natural Gas Producers' has been supplying gas from the area to Fort Morgan and other local markets. Excess gas has been sold to Interstate for use in the Denver metropolitan area.

Utah line approved

Utah's Public Service Commission approved construction of Mountain Fuel Supply Co.'s $10 million pipeline. The line is a joint endeavor of MFS and Utah Natural Gas Co.

The line will bring gas from eastern Utah to the central area of the state.

10-year firm price set for gas purchase

An FPC order approving the settlement agreement between Texas Gas Transmission Corp. and Union Texas Natural Gas Corp. represents the disposal of one of the largest producer rate increases in FPC's history.

The settlement establishes a firm fixed price for gas to be purchased from Union Texas for the remaining length of the contract, a period a little in excess of 10 years.

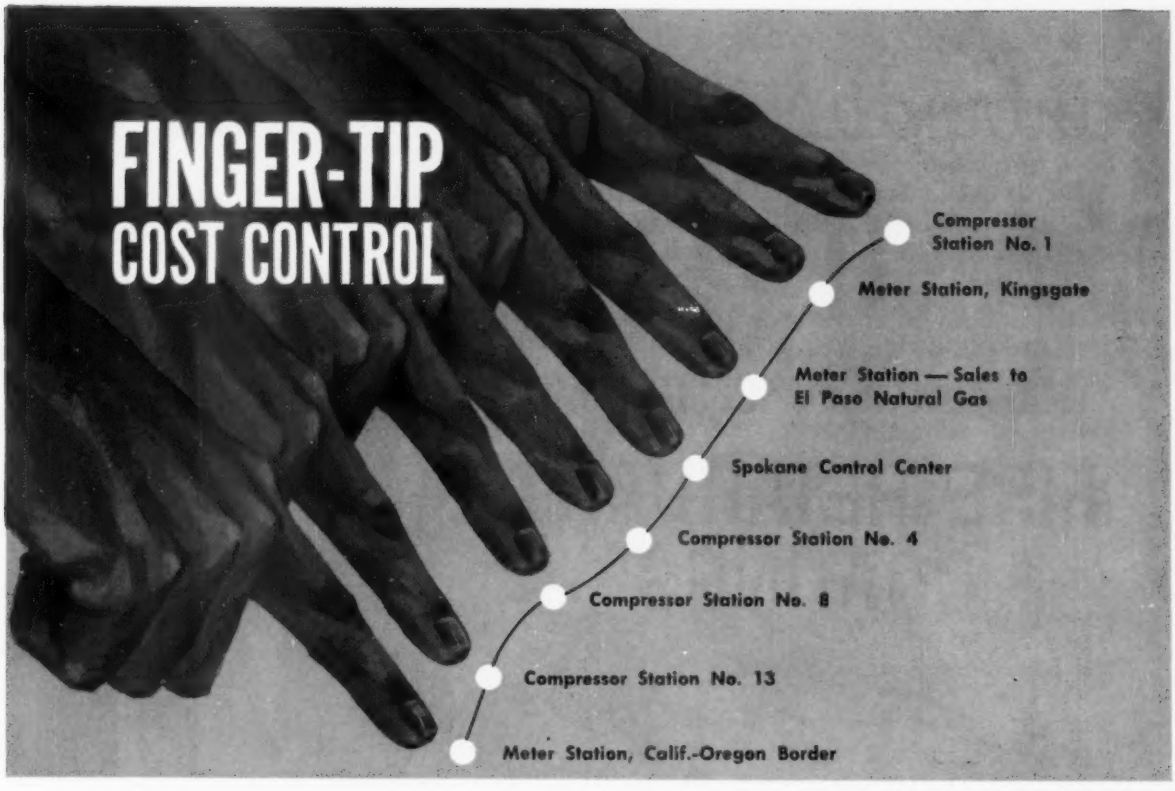
Texas Gas president W. M. Elmer said the new price "applies to more than 30 per cent of Texas Gas' total field purchases, and to the extent of my knowledge, represents the only major producer contract with a fixed price throughout the entire term."

The firm price agreed upon is 16 cents/Mcf for non-dehydrated gas and 16¼ cents for dehydrated gas. Under terms of the agreement and based on 1960 actual purchases, the savings to Texas Gas in the cost of gas purchased from Union amount to about $2.5 million annually.

Deleted are all indefinite pricing and fixed period price increase clauses from Union's contracts with Texas Gas.

Committed to Texas Gas under the contract are about 1.5 trillion cu ft of gas reserves at a firm price through Dec. 31, 1971.

In 1956, Union filed for an increase from 9.247 cents to 19.186 cents/Mcf for dehydrated gas. The decision in the Phillips case prevented the increase from becoming effective automatically. So, the higher price has been collected by Union since 1957, subject to refund. Thus, refunds amounting to approximately $10.5 million will be paid to Texas Gas.

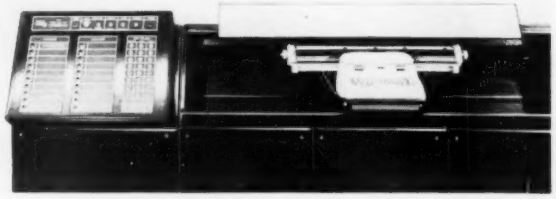


Dresser Electronics/SIE solid-state control system chosen by Pacific Gas Transmission Company and Alberta Natural Gas Company.

Dresser/SIE equipment will be used to automate the 722-mile Pacific Northwest portion of the new Alberta-California pipeline system. The new transistorized equipment will provide reliable service and help participating companies keep operating costs low.

Stable, solid-state control systems using transistors – with no moving parts and no known failure mechanisms – provide the highest reliability available for pipeline service. Information transmission errors are eliminated through the use of digital techniques. Plug-in modules allow easy automation system growth to match users' needs . . . maintenance personnel do not need extensive electronic knowledge. This proved solid-state equipment from Dresser/SIE uses "computer language" throughout for instant addition of complete computer control later.

Get the facts on how *you* can reduce costs. . . . Call Dresser Electronics/SIE Division.



From consoles similar to this one, the Spokane control center will control flow from Alberta to the California-Oregon Border Meter Station. Local station discharge pressures are maintained at either remotely-set or locally-set values by automatic speed control and selection of active units. Secondary control for reciprocating compressor units to keep operation at rated torque will be provided from a pocket-clearance computer-controller; centrifugal compressors will have speed and inlet vane position control along with surge control. Automatic compressor start-up is provided for all pumping stations included in the supervisory system.

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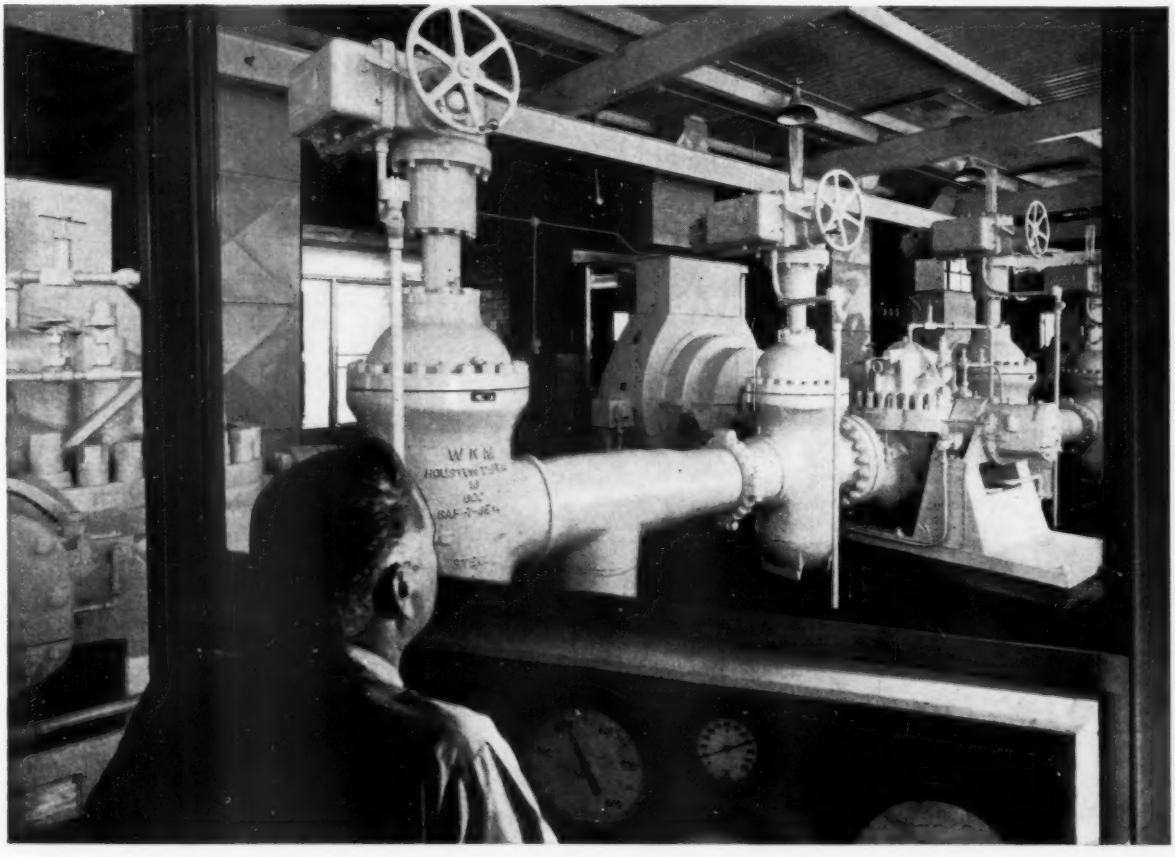

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Champ Gasco vs. Kid Enchilada—round 6

Well, folks, round 6 in this sensational battle for the Southern California gasweight championship is over and most ringsiders rate it even. What originally looked like a potential k.o. punch to Kid Enchilada's bread-basket turned out to be just another low blow. The ref said both boys had been hitting below the belt, and warned them to keep 'em up. They did and spent the rest of the round in unspectacular infighting.

That sums up the sixth round (Los Angeles, July 10-14) of California PUC hearings involving that proposed Mexican-American pipeline, the Enchilada Inch.

During the round, the commission ruled out that potential press kit k.o. (July GAS, pp 118-119). The SoCal-SoCounties motion for dismissal or declaration of mistrial was a case of "the pot calling the kettle black," in the commission's own words. It did find the California Gas Transmission Co. kit "contrary to the spirit of the instructions and admonition of the commission," but added that "such violation was unintentional." It found Cal-Counties' publicity guilty of a similar violation and set aside their motion.

In the hearing room, the infighting of cross-examination wore on through the week. The principal witness — on the stand for three days—was Sherman H. Clark, who earlier testified that the Enchilada Inch would save southern Californians $174 million. Also cross-examined were: Robert P. O'Brien, SoCal Edison; Joseph L. Parrish Jr., Tennessee Gas Pipeline Co.; Robert W. Harrison, a consulting engineer; and S. Smith Griswold and Robert L. Chass, both of the Los Angeles Air Pollution District.

The fight resumes Sept. 25-27 with round 7. First witness is to be former FPC commissioner William R. Connole. He will be followed by Serapion Fernandez and Alfonso Barnetche, both of Petroleos Mexicanos, and probably Harrison again. Midway through the round, the Cal-Counties interests are expected to begin to present their case.

The fight is already booked as a 10-rounder, round 8 to take place Oct. 3-6; round 9, Oct. 18-20; and round 10, Nov. 13-17.

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FPC repeats "no" to TGT's Canadian plan

Tennessee Gas Transmission Co., Houston, has been turned down for the second time in its effort to import natural gas from Canada on an interruptible basis.

TGT proposed taking up to 204 MMcfd on an as, if, and when-available basis from Trans-Canada Pipe Lines Ltd., Toronto. Delivery would have been near Niagara Falls, N. Y., where the two companies have an existing interconnection.

When Presiding Examiner Harry W. Frazee turned down the plan for the first time (September 1960), he said TGT had failed to show: a market for the gas, that the proposed price was in the public interest, or a gas purchase contract with Trans-Canada. Last October FPC reopened the hearings so that TGT could submit additional evidence substantiating its plans.

In turning down the proposal for a second time, Frazee said TGT failed to sustain, by a preponderance of evidence that the proposal is in the public interest. Among other things, he said TGT still has not offered any market data nor shown a need for the gas. On the contrary, he said, it has now, and perhaps for the foreseeable future, adequate supplies of natural gas derived from cutbacks of its present customers with which to fill its storage to capacity.

Rock Springs hearings launched

Hearings are under way in Washington on the Rock Springs project to supply an additional 470 MMcfd to southern California markets.

FPC didn't act on petitions filed by two subsidiaries of Tennessee Gas Transmission seeking intervention in the proceedings. The subsidiaries—Tennessee California Gas Transmission Co. and California Gas Transmission Co.—also asked that their Enchilada Inch plan to serve California be consolidated with the Rock Springs plan for comparative and simultaneous hearing and decision.

Turbocharging boosts station capacity

Richfield Oil Corp. is boosting its gas compression facilities in California by turbocharging more than 30 Clark gas engine compressor units. Using a method applying multiple AiResearch turbochargers per engine, Richfield is adding nearly the equivalent of a new plant generating 9000 hp.

Small, high production type AiResearch turbochargers are adding a healthy 25 to 35 per cent increase to the normal power ratings of a variety of Clark engine models.

FPC hears Transwestern

FPC is hearing Transwestern Pipeline Co.'s plan to build $8.6 million in gas facilities.

Transwestern wants to build 250 miles of pipeline ranging in size from 4-in. to 12-in.; 8040 hp in three new compressor stations; and metering and dehydrating facilities.

Transwestern has temporary authority to construct and operate the facilities which will enable it to take into its main system gas from various producers in the Panhandle area of Texas, Oklahoma and Kansas and in the Permian Basin area of Texas and New Mexico.

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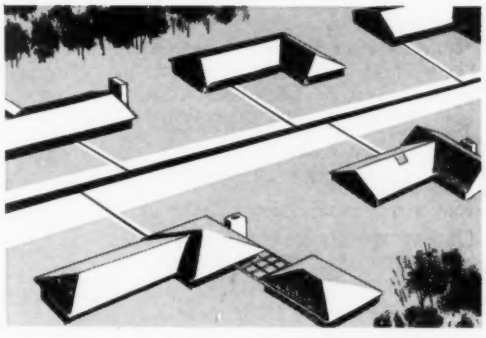

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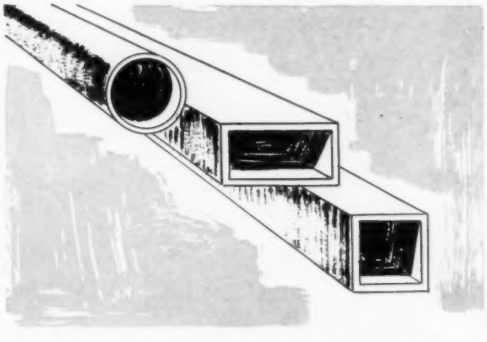

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Ohio Oil Co. is expanding the capacity of its casinghead gas processing plant near Mosherville, Mich., by about 50 per cent. Initial capacity of the year-old plant was 25 MMcfd. Included in the expansion program is 12 miles of 12¾-in. gathering line.

The first U. S. installation of Driam-produced spiral-weld pipe for a distribution system was laid recently in Ohio. Driam Corp. announced that the Patent Office has allowed its basic claims for a U. S. patent.

Tube Turns has appointed Tripoli Sales Co. as authorized distributor in Libya for its welding fittings, flanges, and other piping components.

Quindar Electronics, Bloomfield, N. J., has completed the development phase of two new lines of advanced tone signalling systems. Quantity production is now under way. According to company president Arthur M. Lerner, this completes the first schedule phase of a 15-month formation program.

M-A-C—Cont. from page 127

ing special schools. To each of these men, I would say "Congratulations—stick with it."

For men in industry today must continue their efforts to improve their minds — to enlarge their knowledge of not only their own activities but also of activities in related fields. Rewards for this extra-curricular effort most likely will not come from your immediate supervisor or possibly from your company. But your reward shall be in your understanding of new developments, new techniques and new theories while others are lost in the fog.

Daniel Orifice Fitting Co. of Houston and Los Angeles has entered the electronics field with the formation of Daniel Electronics. The new division will be under the direction of Larry J. Stroman, formerly with SIE division of Dresser Electronics. Daniel recently showed its multiplex orifice fitting permitting the positioning of any one of five orifice plates in the meter tube. The five plates will cover the range of Beta ratios for the

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meter tube used. They have also shown their Duomatic fitting whereby either of two orifice plates may be positioned in the flow stream. Although Daniel has not announced the exact functions of the new division, it is likely that it will work towards the development of associated equipment for use with Duomatic and multiplex fittings.

We are told that Pacific Gas Transmission Co. will automate the compressor stations on its line from Canada to California using solid-state equipment from SIE division of Dresser Electronics. Editor Ebdon, who made a tour of the PGT line in May, indicated that future plans of Pacific Gas Transmission in the direction of automation will place the company in the front ranks in the use of automated facilities in the country. Editor Ebdon's article on progress to date on the PGT pipeline makes very interesting reading in this issue of GAS.

ToPaz Inc., Houston, has recently introduced its new high pressure mercury manometer, appropriately called the Topazometer. The instrument permits the accurate measurement of pressure differentials from 0 to 1000 in. of water using standard scales, at operating pressures to 2000 psig. The unit weighs 26 lb, plus the scales, and may be carried in a case measuring 12 x 12 x 10 in., making it very portable. ToPaz advocates the use of the instrument for sensing pressure drops across flow fittings, scrubbers, desiccant beds and for making gas well deliverability tests. The instrument is particularly useful for testing orifice meters at operating pressure conditions.

For the distribution field, the ToPaz instrument will be of particular interest in checking low pressure gauges and in searching for pressure drops. American Meter Co. displayed its automatic meter prover at the recent Southwest Gas Measurement short course. The automatic prover offers faster, more accurate proving of domestic meters. Mention was made at the National Telemetering Conference in Chicago of an eastern company telemetering domestic meter readings to its control center by use of telephone circuits. More to come on this in the coming month. ■

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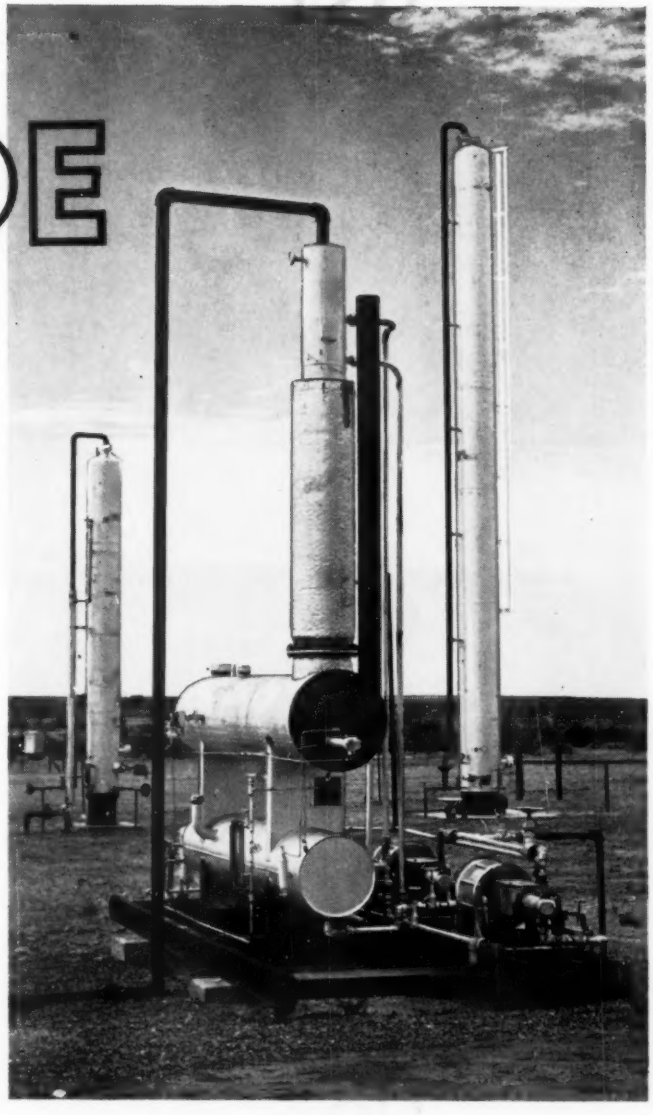

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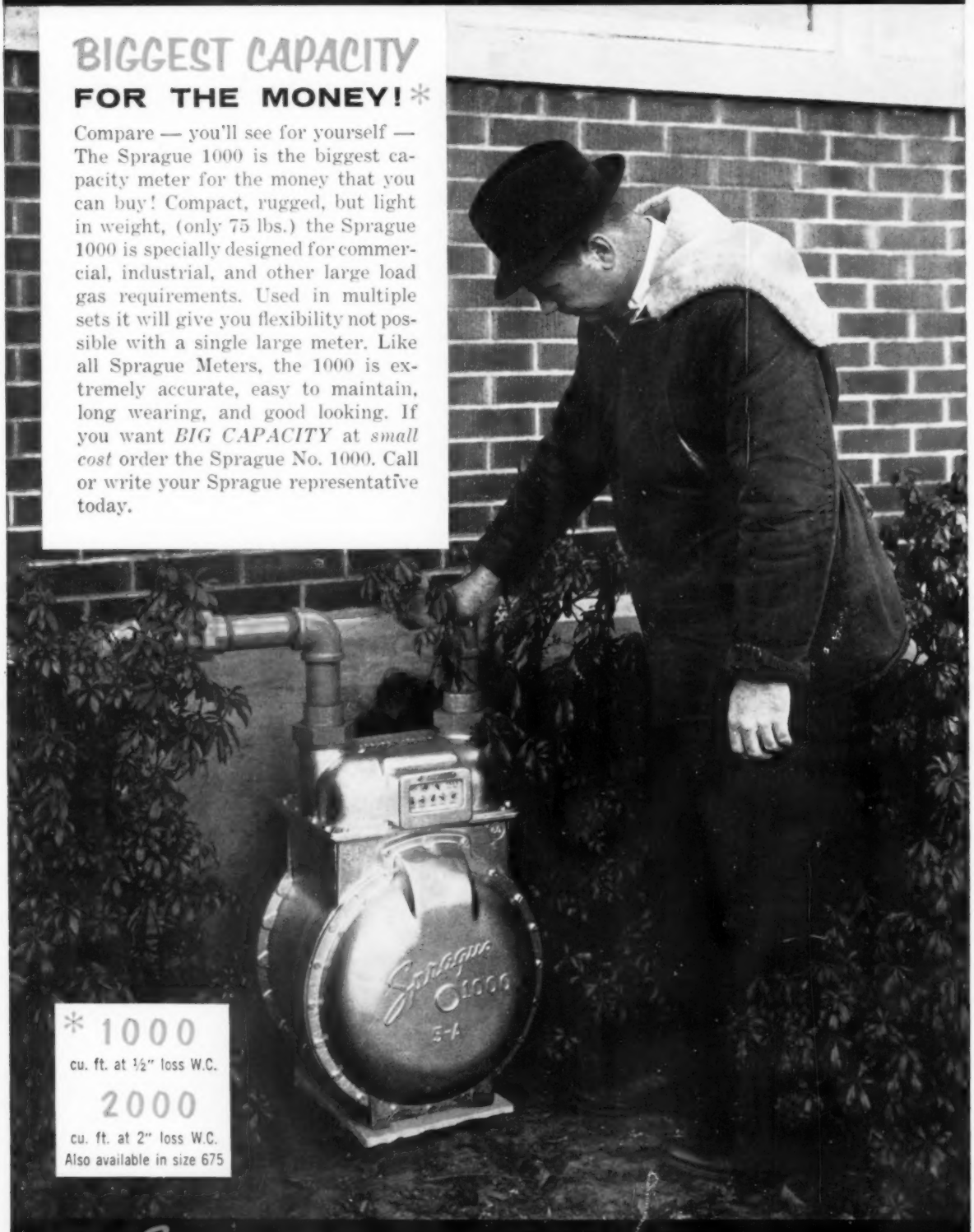

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